Aries Newark Biochar Production Facility (09444) Date: 12/1/2020

New Jersey Department of Environmental Protection
Reason for Application

Permit Being Modified

Permit Class: **Number:** 0

Description of Modifications:

Aries Clean Energy is developing a project in Newark, New Jersey to process treated biosolids into beneficial biochar, the "Newark Biochar Production Facilty" or the Facility. This Plant will be an Aries Design, Build, Own, Operate, and Maintain (DBOOM) project controlled and managed by Aries and will utilize the Aries Fluidized Bed Gasifier to process and dispose of up to 430 wet tons of domestic wastewater treated biosolids daily. The project will built on an existing site on the Passaic River.

Aries Clean Energy is an independent, self-controlled company managed by a Board of Directors and Executive Management team and will control the full development, engineering, construction, and operation of the Facility.

The Plant will consist of truck unloading and receiving stations for biosolids, biosolids storage, biosolids dryers, dried biosolids storage, a fluidized bed gasification unit, producer gas combustion and heat recovery system, emissions control system, aqueous ammonia unloading and storage, hydrated lime unloading and storage, and truck loadout facilities for dried biosolids, spent sorbent, and biochar by-products.

The facility will process domestic treated biosolids of between 70 - 82% moisture from 3rd parties. The 3rd party biosolids will be delivered by truck to the plant for unloading and storage in biosolids bins. Dryers will process the biosolids to produce dried biosolids at 10% moisture content that will primarily be used as fuel for the gasifier.

The gasifier will convert the dried biosolids to producer gas and biochar. The producer gas is used as the fuel for a direct fired thermal oxidizer that will provide the thermal energy required to heat air and dry the biosolids in rotary drum dryers. The biochar is a byproduct that consists primarily of ash and a small amount of residual unconverted carbon.

New Jersey Department of Environmental Protection
Facility Profile (General)

Facility Name (AIMS): Aries Newark Biochar Production Facility

Facility ID (AIMS): 09444

Street Address: 400 DOREMUS AVE
NEWARK, NJ 07105

Mailing Address: 4037 RURAL PLNS CIR
STE 290
FRANKLIN, TN 37064

State Plane Coordinates:

X-Coordinate:	596,323
Y-Coordinate:	686,998
Units:	Feet
Datum:	NAD83
Source Org.:	DEP-GIS
Source Type:	Center of Facility

County: Essex

Location Description: The site is located on an existing privateley owned site on the Passaic river.
Aries HQ is located in Franklin TN.

Industry:

Primary SIC:	
Secondary SIC:	
NAICS:	221320

New Jersey Department of Environmental Protection
Facility Profile (General)

Contact Type: Air Permit Information Contact

Organization: Aries Clean Energy
Org. Type: LLC
Name: Ron Hudson
NJ EIN: 00831069598
Title: Director, Environmental and Permitting
Phone: (615) 550-8585 x
Fax: ( ) - x
Other: (303) 956-1879 x
Type: Mobile
Email: ron.hudson@ariesenergy.com
Mailing Address: 4037 Rural Plains Circle
Suite 290
Franklin, TN 37064

Contact Type: Fees/Billing Contact

Organization: Aries Clean Energy
Org. Type: LLC
Name: Renus Kelfkens
NJ EIN: 00831069598
Title: SVP Engineering
Phone: (615) 616-8237 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: Renus.Kelfkens@ariesenergy.com
Mailing Address: 4037 Rural Plains Circle
Suite 290
Franklin, TN 37064

Contact Type: General Contact

Organization: Aries Clean Energy
Org. Type: LLC
Name: Renus Kelfkens
NJ EIN: 00831069598
Title: SVP Engineering
Phone: (615) 616-8237 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: Renus.Kelfkens@ariesenergy.com
Mailing Address: 4037 Rural Plains Circle
Suite 290
Franklin, TN 37064

New Jersey Department of Environmental Protection
Facility Profile (General)

Contact Type: Owner (Current Primary)

Organization: Aries Clean Energy
Org. Type: LLC
Name: Aries Clean Energy
NJ EIN: 00831069598
Title: Owner
Phone: (615) 616-8237 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: Renus.Kelfkens@ariesenergy.com

Mailing Address: 4037 Rural Plains Circle
Suite 290
Franklin, TN 37064

Contact Type: Responsible Official

Organization: Aries Clean Energy
Org. Type: LLC
Name: Renus Kelfkens
NJ EIN: 00831069598
Title: SVP Engineering
Phone: (615) 616-8237 x
Fax: ( ) - x
Other: ( ) - x
Type:
Email: Renus.Kelfkens@ariesenergy.com

Mailing Address: 4037 Rural Plains Circle
Suite 290
Franklin, TN 37064

New Jersey Department of Environmental Protection
Equipment Inventory

Equip. NJID	Facility's Designation	Equipment Description	Equipment Type	Certificate Number	Install Date	Grand-Fathered	Last Mod. (Since 1968)	Equip. Set ID
E1	Receiving	Biosolids Receiving & Storage Bin 1	Storage Vessel		12/27/2021	No		
E2	Receiving	Biosolids Receiving & Storage Bin 2	Storage Vessel		12/27/2021	No		
E3	Feed Bin	Gasifier Feed Bin 1	Manufacturing and Materials Handling Equipment		12/27/2021	No		
E4	Feed Bin	Gasifier Feed Bin 2	Manufacturing and Materials Handling Equipment		12/27/2021	No		
E5	Gasifier	Aries Fluidized Bed Gasifier	Manufacturing and Materials Handling Equipment		12/27/2021	No		
E6	Biosolid Bin	Biosolids Loadout Bin	Manufacturing and Materials Handling Equipment		12/27/2021	No		
E7	Biochar Bin	Biochar Loadout Bin	Manufacturing and Materials Handling Equipment		12/27/2021	No		

New Jersey Department of Environmental Protection
Control Device Inventory

CD NJID	Facility's Designation	Description	CD Type	Install Date	Grand-Fathered	Last Mod. (Since 1968)	CD Set ID
CD1	GasifCyclone	Gasifier Cyclone	Cyclone	12/27/2021	No		
CD2	Gasifier TO	Thermal Oxidizer 2	Oxidizer (Thermal)	12/27/2021	No		
CD3	EmissionCont	Tri-mer Emissions Control System (SOx NOx and PM Removal)	Other	12/27/2021	No		
CD4	Biosolids PM	Biosolids Loadout PM Control	Other	12/27/2021	No		
CD5	Biochar Pm	Biochar Loadout PM Control	Other	12/27/2021	No		

Aries Newark Biochar Production Facility (09444)

Date: 12/1/2020

New Jersey Department of Environmental Protection
Emission Points Inventory

PT NJID	Facility's Designation	Description	Config.	Equiv. Diam. (in.)	Height (ft.)	Dist. to Prop. Line (ft)	Exhaust Temp. (deg. F)			Exhaust Vol. (acfm)			Discharge Direction	PT Set ID
							Avg.	Min.	Max.	Avg.	Min.	Max.		
PT1	Plant Stack	Biochar Manufacturing Plant Exhaust Stack	Round	100	130	100	500.0	350.0	1,250.0	51,882.0	25,000.0	55,123.0	Up	
PT2	Biochar Bin	Biochar Bin Filter Exhaust	Square	28	2	105	85.0	35.0	180.0	20.0	10.0	25.0	Up	

Aries Newark Biochar Production Facility (09444)

Date: 12/1/2020

New Jersey Department of Environmental Protection
Emission Unit/Batch Process Inventory

U 1 Biochar Prod Aries Newark Biochar Production Facility

UOS NJID	Facility's Designation	UOS Description	Operation Type	Signif. Equip.	Control Device(s)	Emission Point(s)	SCC(s)	Annual Oper. Hours Min.	Annual Oper. Hours Max.	VOC Range	Flow (acfm) Min.	Flow (acfm) Max.	Temp. (deg F) Min.	Temp. (deg F) Max.
OS1	Receiving	Biosolids Receiving in Bin 1	Normal - Steady State	E1	CD2 (P) CD3 (S)	PT1		0.0	3,139.0		0.1	15.0	35.0	100.0
OS2	Receiving	Biosolids Receiving in Bin 2	Normal - Steady State	E2	CD2 (P) CD3 (S)	PT1		0.0	3,139.0		0.1	15.0	35.0	100.0
OS3	Storage	Biosolids Storage in Bin 1	Normal - Steady State	E1	CD2 (P) CD3 (S)	PT1		0.0	8,760.0		0.1	90.0	35.0	100.0
OS4	Storage	Biosolids Storage in Bin 1	Normal - Steady State	E2	CD2 (P) CD3 (S)	PT1		0.0	8,760.0		0.1	90.0	35.0	100.0
OS5	GasifierFeed	Dried Biosolids Feed 1 to Gasifier	Normal - Steady State	E3	CD2 (P) CD3 (S)	PT1		0.0	8,250.0		0.1	15.0	35.0	180.0
OS6	GasifierFeed	Dried Biosolids Feed 2 to Gasifier	Normal - Steady State	E4	CD2 (P) CD3 (S)	PT1		0.0	8,250.0		0.1	15.0	35.0	180.0
OS7	Gasification	Normal Gasifier Operation	Normal - Steady State	E5	CD1 (P) CD2 (S) CD3 (T)	PT1		7,446.0	8,250.0		10,000.0	30,000.0	250.0	850.0
OS8	GasifierDown	Gasifier Down	Maintenance	E5	CD2 (P) CD3 (S)	PT1		510.0	7,446.0		10,000.0	30,000.0	250.0	850.0
OS9	Bin Load	Biosolids Bin Loading	Maintenance	E6	CD2 (P) CD3 (S)	PT1		0.0	8,250.0		0.1	30.0	35.0	100.0
OS10	Truck Load	Biosolids Truck Load out	Maintenance	E6	CD2 (S) CD3 (T) CD4 (P)	PT1		0.0	2,920.0		0.1	30.0	35.0	100.0
OS11	Char Load	Biochar Bin Loading	Normal - Steady State	E7	CD5 (P)	PT2		0.0	8,250.0		0.1	25.0	35.0	100.0

New Jersey Department of Environmental Protection
Emission Unit/Batch Process Inventory

U 1 Biochar Prod Aries Newark Biochar Production Facility

UOS NJID	Facility's Designation	UOS Description	Operation Type	Signif. Equip.	Control Device(s)	Emission Point(s)	SCC(s)	Annual Oper. Hours Min.	Annual Oper. Hours Max.	VOC Range	Flow (acfm) Min.	Flow (acfm) Max.	Temp. (deg F) Min.	Temp. (deg F) Max.
OS12	Char Truck	Biochar Truck Loadout	Normal - Steady State	E7	CD5 (P)	PT2		0.0	2,920.0		0.1	25.0	35.0	100.0

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: U1 Biochar Prod

Operating Scenario: OS0 Summary

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
CO	0.00000000	12,378.40000000	12.38000000	12.38000000	tons/yr	No
HAPs (Total)	0.00000000	123.00000000	1.23000000	1.23000000	tons/yr	No
NOx (Total)	0.00000000	374.50000000	18.72000000	18.72000000	tons/yr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	tons/yr	No
PM-10 (Total)	0.00000000	885.30000000	13.02000000	13.02000000	tons/yr	No
SO2	0.00000000	1,137.40000000	45.50000000	45.50000000	tons/yr	No
TSP	0.00000000	885.30000000	13.02000000	13.02000000	tons/yr	No
VOC (Total)	0.00000000	1,768.90000000	8.84000000	8.84000000	tons/yr	No

Subject Item: U1 Biochar Prod

Operating Scenario: OS1

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Ammonia	0.00000000	0.07600000	0.07600000	0.07600000	lb/hr	No
CO	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
HAPs (Total)	0.00000000	0.04000000	0.04000000	0.04000000	lb/hr	No
NOx (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
SO2	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
TSP	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
VOC (Total)	0.00000000	0.03700000	0.03700000	0.03700000	lb/hr	No

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS2**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Ammonia	0.00000000	0.07600000	0.07600000	0.07600000	lb/hr	No
CO	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
HAPs (Total)	0.00000000	0.04000000	0.04000000	0.04000000	lb/hr	No
NOx (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
SO2	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
TSP	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
VOC (Total)	0.00000000	0.03700000	0.03700000	0.03700000	lb/hr	No

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS3**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Ammonia	0.00000000	0.11400000	0.01100000	0.01100000	lb/hr	No
CO	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
HAPs (Total)	0.00000000	0.03000000	0.03000000	0.03000000	lb/hr	No
NOx (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
SO2	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
TSP	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
VOC (Total)	0.00000000	0.06000000	0.00028000	0.00028000	lb/hr	No

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: U1 Biochar Prod

Operating Scenario: OS4

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
Ammonia	0.00000000	0.11400000	0.01100000	0.01100000	lb/hr	No
CO	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
HAPs (Total)	0.00000000	0.03000000	0.03000000	0.03000000	lb/hr	No
NOx (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
SO2	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
TSP	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
VOC (Total)	0.00000000	0.06000000	0.00028000	0.00028000	lb/hr	No

Subject Item: U1 Biochar Prod

Operating Scenario: OS5

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
CO	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
HAPs (Total)	0.00000000	0.00300000	0.00300000	0.00300000	lb/hr	No
NOx (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	1.80000000	0.02000000	0.02000000	lb/hr	No
SO2	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
TSP	0.00000000	1.80000000	0.02000000	0.02000000	lb/hr	No
VOC (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS6**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
CO	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
HAPs (Total)	0.00000000	0.00300000	0.00300000	0.00300000	lb/hr	No
NOx (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	1.80000000	0.02000000	0.02000000	lb/hr	No
SO2	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
TSP	0.00000000	1.80000000	0.02000000	0.02000000	lb/hr	No
VOC (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS7**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
CO	0.00000000	2,993.40000000	2.99000000	2.99000000	lb/hr	No
HAPs (Total)	0.00000000	0.06900000	0.06900000	0.06900000	lb/hr	No
NOx (Total)	0.00000000	89.80000000	4.49000000	4.49000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	194.20000000	1.94000000	1.94000000	lb/hr	No
SO2	0.00000000	275.70000000	11.03000000	11.03000000	lb/hr	No
TSP	0.00000000	194.20000000	1.94000000	1.94000000	lb/hr	No
VOC (Total)	0.00000000	428.20000000	2.14000000	2.14000000	lb/hr	No

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: U1 Biochar Prod

Operating Scenario: OS8

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
CO	0.00000000	8.20000000	0.00800000	0.00800000	lb/hr	No
HAPs (Total)	0.00000000	0.01500000	0.01500000	0.01500000	lb/hr	No
NOx (Total)	0.00000000	1.10000000	0.06000000	0.06000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	0.70000000	0.01000000	0.01000000	lb/hr	No
SO2	0.00000000	0.06000000	0.00200000	0.00200000	lb/hr	No
TSP	0.00000000	0.70000000	0.01000000	0.01000000	lb/hr	No
VOC (Total)	0.00000000	0.50000000	0.00300000	0.00300000	lb/hr	No

Subject Item: U1 Biochar Prod

Operating Scenario: OS9

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
CO	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
HAPs (Total)	0.00000000	0.00230000	0.00230000	0.00230000	lb/hr	No
NOx (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	0.60000000	0.01000000	0.01000000	lb/hr	No
SO2	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
TSP	0.00000000	0.60000000	0.01000000	0.01000000	lb/hr	No
VOC (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS10**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
CO	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
HAPs (Total)	0.00000000	0.00190000	0.00190000	0.00190000	lb/hr	No
NOx (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	2.80000000	0.44100000	0.44100000	lb/hr	No
SO2	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
TSP	0.00000000	2.80000000	0.44100000	0.44100000	lb/hr	No
VOC (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS11**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
CO	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
HAPs (Total)	0.00000000	0.01460000	0.01460000	0.01460000	lb/hr	No
NOx (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	5.20000000	0.05000000	0.05000000	lb/hr	No
SO2	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
TSP	0.00000000	5.20000000	0.05000000	0.05000000	lb/hr	No
VOC (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS12**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
CO	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
HAPs (Total)	0.00000000	0.00190000	0.00000000	0.00000000	lb/hr	No
NOx (Total)	0.00000000	0.00000000	0.00190000	0.00190000	lb/hr	No
Pb	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
PM-10 (Total)	0.00000000	26.40000000	2.84000000	2.84000000	lb/hr	No
SO2	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No
TSP	0.00000000	26.40000000	2.84000000	2.84000000	lb/hr	No
VOC (Total)	0.00000000	0.00000000	0.00000000	0.00000000	lb/hr	No

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS0 Summary**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
PM-2.5 (Total)	0.00000000	885.30000000	13.02000000	13.02000000	tons/yr	No

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS5**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
PM-2.5 (Total)	0.00000000	1.80000000	0.02000000	0.02000000	lb/hr	No

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: U1 Biochar Prod

Operating Scenario: OS6

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
PM-2.5 (Total)	0.00000000	1.80000000	0.02000000	0.02000000	lb/hr	No

Subject Item: U1 Biochar Prod

Operating Scenario: OS7

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
PM-2.5 (Total)	0.00000000	194.20000000	1.94000000	1.94000000	lb/hr	No

Subject Item: U1 Biochar Prod

Operating Scenario: OS8

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
PM-2.5 (Total)	0.00000000	0.70000000	0.01000000	0.01000000	lb/hr	No

Subject Item: U1 Biochar Prod

Operating Scenario: OS9

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
PM-2.5 (Total)	0.00000000	0.60000000	0.01000000	0.01000000	lb/hr	No

New Jersey Department of Environmental Protection
Potential to Emit

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS10**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
PM-2.5 (Total)	0.00000000	2.80000000	0.44100000	0.44100000	lb/hr	No

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS11**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
PM-2.5 (Total)	0.00000000	5.20000000	0.05000000	0.05000000	lb/hr	No

Subject Item: **U1 Biochar Prod**

Operating Scenario: **OS12**

Step:

Air Contaminant Category (HAPS)	Fugitive Emissions	Emissions Before Controls	Emissions After Controls	Total Emissions	Units	Alt. Em. Limit
PM-2.5 (Total)	0.00000000	26.40000000	2.84000000	2.84000000	lb/hr	No

000000 E1 (Storage Vessel)
Print Date: 12/1/2020

What type of contents is this storage vessel equipped to contain by design?	Solids Only
Storage Vessel Type:	Bin
Design Capacity:	650
Units:	tons
Ground Location:	Above Ground
Is the Shell of the Equipment Exposed to Sunlight?	
Shell Color:	
Description (if other):	
Shell Condition:	Light Rust
Paint Condition:	
Shell Construction:	Bolted/Riveted
Is the Shell Insulated?	
Type of Insulation:	
Insulation Thickess (in):	
Thermal Conductivity of Insulation [(BTU)(in)(hr)(ft2)(deg F)]:	
Shape of Storage Vessel:	Cylindrical
Shell Height (From Ground to Roof Bottom) (ft):	42.00
Length (ft):	27.00
Width (ft):	27.00
Diameter (ft):	27.00
Other Dimension	
Description:	
Value:	
Units:	
Fill Method:	
Description (if other):	
Maximum Design Fill Rate:	
Units:	ft^3/min
Does the storage vessel have a roof or an open top?	
Roof Type:	
Roof Height (From Roof Bottom to Roof Top) (ft):	
Roof Construction:	
Primary Seal Type:	
Secondary Seal Type:	
Total Number of Seals:	
Roof Support:	
Does the storage vessel have a Vapor Return Loop?	

Does the storage vessel

Does the storage vessel have a Conservation Vent?	
Have you attached a diagram showing the location and/or the configuration of this equipment?	Yes
Have you attached any manuf.'s data or specifications to aid the Dept. in its review of this application?	Yes
Comments:	This vessel is for multiple days of storage of treated biosolids to ensure continous feedstock for the gasifier

000000 E2 (Storage Vessel)
Print Date: 12/1/2020

What type of contents is this storage vessel equipped to contain by design?	Solids Only
Storage Vessel Type:	Bin
Design Capacity:	650
Units:	tons
Ground Location:	Above Ground
Is the Shell of the Equipment Exposed to Sunlight?	
Shell Color:	
Description (if other):	
Shell Condition:	Light Rust
Paint Condition:	
Shell Construction:	Bolted/Riveted
Is the Shell Insulated?	
Type of Insulation:	
Insulation Thickess (in):	
Thermal Conductivity of Insulation [(BTU)(in)(hr)(ft2)(deg F)]:	
Shape of Storage Vessel:	Cylindrical
Shell Height (From Ground to Roof Bottom) (ft):	42.00
Length (ft):	27.00
Width (ft):	27.00
Diameter (ft):	27.00
Other Dimension	
Description:	
Value:	
Units:	
Fill Method:	
Description (if other):	
Maximum Design Fill Rate:	
Units:	ft^3/min
Does the storage vessel have a roof or an open top?	
Roof Type:	
Roof Height (From Roof Bottom to Roof Top) (ft):	
Roof Construction:	
Primary Seal Type:	
Secondary Seal Type:	
Total Number of Seals:	
Roof Support:	
Does the storage vessel have a Vapor Return Loop?	

Does the storage vessel

000000 E2 (Storage Vessel)
Print Date: 12/1/2020

Does the storage vessel have a Conservation Vent?	
Have you attached a diagram showing the location and/or the configuration of this equipment?	Yes
Have you attached any manuf.'s data or specifications to aid the Dept. in its review of this application?	Yes
Comments:	This vessel is for multiple days of storage of treated biosolids to ensure continous feedstock for the gasifier

000000 E3 (Manufacturing and Materials Handling Equipment)
Print Date: 12/1/2020

Make:	Martin Sprocket
Manufacturer:	Martin Sprocket
Model:	Custom Equipment
Type of Manufacturing and Materials Handling Equipment:	Dried Biosolids Gasifier Feed Bin
Capacity:	5.00E+00
Units:	other units
Description (if other):	tons
Have you attached a diagram showing the location and/or the configuration of this equipment?	Yes
Have you attached any manuf.'s data or specifications to aid the Dept. in its review of this application?	No
Comments:	This Bin holds a small amount of dried biosolids and feeds them to the main gasification system. The prupose of this bin is not for storage but more for holdup to control the feed rate to the gasifier. The bin is under negative pressure and vented to the themal oxidizer.

000000 E4 (Manufacturing and Materials Handling Equipment)
Print Date: 12/1/2020

Make:	Martin Sprocket
Manufacturer:	Martin Sprocket
Model:	Custom Equipment
Type of Manufacturing and Materials Handling Equipment:	Dried Biosolids Gasifier Feed Bin
Capacity:	5.00E+00
Units:	other units
Description (if other):	tons
Have you attached a diagram showing the location and/or the configuration of this equipment?	Yes
Have you attached any manuf.'s data or specifications to aid the Dept. in its review of this application?	No
Comments:	This Bin holds a small amount of dried biosolids and feeds them to the main gasification system. The prupose of this bin is not for storage but more for holdup to control the feed rate to the gasifier. The bin is under negative pressure and vented to the themal oxidizer.

000000 E5 (Manufacturing and Materials Handling Equipment)
Print Date: 12/1/2020

Make:	Aries Clean Energy
Manufacturer:	Aries Manufacturing
Model:	ACE FB100-2000
Type of Manufacturing and Materials Handling Equipment:	Fluidized Bed Gasifier
Capacity:	1.00E+02
Units:	other units
Description (if other):	tons
Have you attached a diagram showing the location and/or the configuration of this equipment?	Yes
Have you attached any manuf.'s data or specifications to aid the Dept. in its review of this application?	Yes

Comments:

The Aries fluidized bed gasifier is a bubbling bed contained in a refractory lined vessel which utilizes quartz sand as the inert bed material to help maintain the proper gasification temperature. Air is injected to achieve partial oxidation of a portion of the biosolids feed material (gasification). The temperature is maintained at 1250Â°F to minimize potential clinker or agglomeration formation by alkali material in the biosolids.

The dried biosolids are converted to a low heating value producer gas and a solid biochar. The resulting producer gas typically has a lower heating value (LHV) in the range of 120-150 Btu/scf. The biochar is discharged mainly from the cyclone while some is discharged at the bottom of the gasifier if needed for level control.

Parameters that will be monitored are as follows:

-Bed temperature profile to ensure good distribution of biosolids and air throughout the be

-Average temperature at the feed level to control air flow rate

-Pressure drop across a fixed portion of the bed to measure bed density

-Pressure drop across the entire bed to measure bed height using density

-Gasifier outlet pressure

000000 E6 (Manufacturing and Materials Handling Equipment)
Print Date: 12/1/2020

Make:	Hamilton Industries
Manufacturer:	Hamilton Industries
Model:	Custom Equipment
Type of Manufacturing and Materials Handling Equipment:	Biosolids Loadout Bin
Capacity:	3.50E+02
Units:	other units
Description (if other):	tons
Have you attached a diagram showing the location and/or the configuration of this equipment?	Yes
Have you attached any manuf.'s data or specifications to aid the Dept. in its review of this application?	Yes
Comments:	This bin is used to store dried biosolids in the event that the gasifier is down for maintenance. The dried biosolids have the ability to be loaded into a truck. The bin is under negative pressure and vented to the themal oxidizer. Data sheet is included in additional information package.

000000 CD1 (Cyclone)
Print Date: 12/1/2020

Make:	Custom
Manufacturer:	Aries
Model:	Custom
Unit Type:	Single
Description:	
Major Cylinder Diameter, Dc (ft):	6.15
Major Cylinder Length, Lc (ft):	24.60
Gas Outlet Diameter, De (ft):	3.08
Gas Inlet Height, He (ft):	3.08
Gas Inlet Width, Bc (ft):	1.03
Gas Outlet Length, Hc + Sc [usually 5/8 Dc] (ft):	3.84
Cone Length, Zc (ft):	12.30
Dust Outlet, Jc (ft):	2.31
Effective Number of Turns, Ne:	6
Inlet Gas Velocity, Vi (ft/min):	70.00
True Particle Density (lbs/ft^3):	35.00
Average Particle Size (micrometers):	25.00
Gas Temperature (°F):	1,250.0
Have you attached a Particle Size Distribution Analysis?	(●) Yes ( ) No
Maximum Number of Sources Using this Apparatus as a Control Device (Include Permitted and Non-Permitted Sources):	1
Alternative Method to Demonstrate Control Apparatus is Operating Properly:	Pressure drop across cyclone.
Have you attached data from recent performance testing?	( ) Yes (●) No
Have you attached any manufacturer's data or specifications in support of the feasibility and/or effectiveness of this control apparatus?	(●) Yes ( ) No
Have you attached a diagram showing the location and/or configuration of this control apparatus?	(●) Yes ( ) No
Comments:	The cyclone is used for the removal of the airborne ash and particulate matter entrained in the producer gas resulting from the gasification process. The cyclone with an efficiency of 90% will remove most of the airborne ash and particulate matter, leaving a cleaned producer gas for transfer and combustion within the thermal oxidizer. The ash will be removed from the bottom of the cyclone and gasifier using a screw conveyor which will periodically discharge the ash to the biochar storage bin. PSD < 0.5mm -- 0.40%

< 0.5mm -- 0.40%

0.5-1mm -- 0.50%

1-2mm -- 7.20%

2-4mm -- 36.80%

4-8mm -- 41%

8-16mm -- 14.10%

16-25mm -- 0%

25-50mm -- 0%

>50mm -- 0%

000000 CD2 (Oxidizer (Thermal))
Print Date: 12/1/2020

Make:	Process Combustion Corp
Manufacturer:	Process Combustion Corp
Model:	Custom Equipment
Minimum Chamber Temperature (°F):	1800.0
Minimum Residence Time (sec):	1.00
Fuel Type:	Other
Description:	Natural Gas and Producer Gas
Maximum Rated Gross Heat Input (MMBtu/hr):	60.00
Maximum Number of Sources Using this Apparatus as a Control Device (Include Permitted and Non-Permitted Sources):	4
Alternative Method to Demonstrate Control Apparatus is Operating Properly:	See comments. Not enough characters
Have you attached data from recent performance testing?	Yes ○ No ●
Have you attached any manufacturer's data or specifications in support of the feasibility and/or effectiveness of this control apparatus?	Yes ● No ○
Have you attached a diagram showing the location and/or configuration of this control apparatus?	Yes ● No ○
Comments:	Alternative Method to Demonstrate Control Apparatus is Operating Properly: For VOC control, the primary indicators of thermal oxidizer performance are the outlet exhaust gas VOC concentration and the combustion chamber temperature. Other indicators of thermal oxidizer performance include outlet exhaust gas CO concentration, exhaust gas flow rate, fan current, outlet CO2 concentration, outlet O2 concentration, and auxiliary fuel line pressure. For CO control, the indicators of performance are the same as for VOC control, with the exception of outlet VOC and CO2 concentrations, which would not be monitored for a CO emissions limit. Datasheet included in additional info.

000000 CD3 (Other)
Print Date: 12/1/2020

Make:	UltraCat Catalytic Ceramic Filter (UCF) System
Manufacturer:	Tri-mer Corporation
Model:	UCF Type 3
Maximum Air Flow Rate to Control Device (acfm):	55123.0
Maximum Temperature of Vapor Stream to Control Device (°F):	900.0
Minimum Temperature of Vapor Stream to Control Device (°F):	350.0
Minimum Moisture Content of Vapor Stream to Control Device (%):	10.6
Minimum Pressure Drop Across Control Device (in. H20):	0.100
Maximum Pressure Drop Across Control Device (in. H20):	14.000
Maximum Number of Sources Using this Apparatus as a Control Device (Include Permitted and Non-Permitted Sources):	4
Alternative Method to Demonstrate Control Apparatus is Operating Properly:	see commen
Have you attached data from recent performance testing?	○ Yes ● No
Have you attached any manufacturer's data or specifications in support of the feasibility and/or effectiveness of this control apparatus?	● Yes ○ No
Have you attached a diagram showing the location and/or configuration of this control apparatus?	● Yes ○ No

Comments:

FOR A FULL DESCRIPTION PLEASE SEE ACCOMPANYING PROCESS DESCRIPTION DOCUMENT.

An emission control system will be installed to reduce the NOx and ammonia, SOx and HCl, and particulate emissions. All removal will occur in one unique unit that combines dry sorbent injection, Ammonia injection and a filter house utilizing ceramic filter instead of bags to remove particulate, spent sorbent and convert NOx as it passes through the filter containing embedded SCR Catalyst.

NOx System:
Uses 19% Ammonia Injectionand vanadium pentoxide catalyst. Catalyst is in micronized form and embedded within the ceramic filter media.
Because of the enormous surface area generated by making the catalyst into extremely fine pieces, there is a huge excess of catalyst surface area for reaction in the system, much more than is necessary for the NOx removal necessary in this specific application. The filter elements have a set amount of catalyst that is embedded during manufacture of the filters, as needed for very high NOx loads. There will be a CEMS system to monitor and report NOx, CO2, O2, and NH3. Monitoring point for the CEMs will be on the outlet of the Exhaust stack. The ammonia slip will be monitored and this will be used to control the amount of ammonia injected and alsodetermine if there is a broken filter in

the system.

PM/SOx System:
The SOx removal is part of the filter house system. The filter house captures SOx and PM. For the gravimetric feeder will introduce sorbent into the convey line utilizing a rotary airlock as the primary seal between the feeder and convey line. A positive displacement blower will provide motive air to convey the hydrated lime into the duct upstream of the ceramic filter housing distribution inlet. The sorbent disperses into the duct and begins removing the SO2. The sorbent powder is captured on the outside of the ceramic filters and forms a thin cake, where capture of the SO2 continues as exhaust passes through the filters.

000000 CD4 (Other)
Print Date: 12/1/2020

Make:	Custom
Manufacturer:	Aries
Model:	Custom
Maximum Air Flow Rate to Control Device (acfm):	23.0
Maximum Temperature of Vapor Stream to Control Device (°F):	85.0
Minimum Temperature of Vapor Stream to Control Device (°F):	20.0
Minimum Moisture Content of Vapor Stream to Control Device (%):	10.0
Minimum Pressure Drop Across Control Device (in. H20):	2.000
Maximum Pressure Drop Across Control Device (in. H20):	15.000
Maximum Number of Sources Using this Apparatus as a Control Device (Include Permitted and Non-Permitted Sources):	1
Alternative Method to Demonstrate Control Apparatus is Operating Properly:	Visual inspec
Have you attached data from recent performance testing?	No
Have you attached any manufacturer's data or specifications in support of the feasibility and/or effectiveness of this control apparatus?	No
Have you attached a diagram showing the location and/or configuration of this control apparatus?	Yes
Comments:	The control device for this part of the process has yet to be chosen, emission stream characteristics are from the heat and material balance and control device operational parametric data use are typical for particulate control equipment of this type.

000000 CD5 (Other)
Print Date: 12/1/2020

Make:	Custom
Manufacturer:	Aries
Model:	Custom
Maximum Air Flow Rate to Control Device (acfm):	23.0
Maximum Temperature of Vapor Stream to Control Device (°F):	85.0
Minimum Temperature of Vapor Stream to Control Device (°F):	20.0
Minimum Moisture Content of Vapor Stream to Control Device (%):	10.0
Minimum Pressure Drop Across Control Device (in. H20):	2.000
Maximum Pressure Drop Across Control Device (in. H20):	15.000
Maximum Number of Sources Using this Apparatus as a Control Device (Include Permitted and Non-Permitted Sources):	1
Alternative Method to Demonstrate Control Apparatus is Operating Properly:	Visual inspec
Have you attached data from recent performance testing?	Yes ○ No ●
Have you attached any manufacturer's data or specifications in support of the feasibility and/or effectiveness of this control apparatus?	Yes ○ No ●
Have you attached a diagram showing the location and/or configuration of this control apparatus?	Yes ● No ○
Comments:	The control device for this part of the process has yet to be chosen, emission stream characteristics are from the heat and material balance and control device operational parametric data use are typical for particulate control equipment of this type.

Volume of Gas Discharged from this source (acfm):	12.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS5 (Raw Materials)
Print Date: 12/1/2020

Raw Material	CAS Number	Physical State	Molecular Weight (lbs/lbs-mole)	Does the Material Contain VOC?	Weight Fraction (%)	Vapor Pressure @ 70 deg F (mmHg)	Organic Density	Units
Ash		Sludge	78.000	No				
Carbon		Sludge	12.000	No				
H2O		Sludge	18.000	No				
Hydrogen	01333-74-0	Sludge	1.000	No				
N2		Sludge	14.000	No				
O2		Sludge	16.000	No				
Sulfur		Sludge	32.000	No				

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS5 (Oxidizer (Thermal) - CD2)
Print Date: 12/1/2020

Maximum Feed Rate to the Oxidizer (tons/hr):	0.02
Maximum Air Supply Flow Rate (acfm):	15.0
Minimum Air Supply Flow Rate (acfm):	0.1
Oxygen Content in Exhuast (%O2):	5.00
CO Concentration in Exhaust (ppmvd):	0.000001
Total VOC Concentration in Exhaust (ppmvd):	0.000001

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS5 (Efficiency Table - CD3)
Print Date: 12/1/2020

Pollutant Category	Capture Efficiency (%)	Removal Efficiency (%)	Overall Efficiency (%)
CO	100.00	99.99	99.99
HAP (Total)	100.00	95.00	95.00
NOx	100.00	95.00	95.00
Other (Total)	100.00	90.00	90.00
Pb	100.00	99.00	99.00
PM-10	100.00	99.00	99.00
PM-2.5	100.00	99.00	99.00
SO2	100.00	96.00	96.00
TSP	100.00	99.00	99.00
VOC (Total)	100.00	99.00	99.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS6 (Raw Materials)
Print Date: 12/1/2020

Raw Material	CAS Number	Physical State	Molecular Weight (lbs/lbs-mole)	Does the Material Contain VOC?	Weight Fraction (%)	Vapor Pressure @ 70 deg F (mmHg)	Organic Density	Units
Ash		Sludge	78.000	No				
Carbon		Sludge	12.000	No				
H2O		Sludge	18.000	No				
Hydrogen	01333-74-0	Sludge	1.000	No				
N2		Sludge	14.000	No				
O2		Sludge	16.000	No				
Sulfur		Sludge	32.000	No				

Volume of Gas Discharged from this source (acfm):	12.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS6 (Oxidizer (Thermal) - CD2)
Print Date: 12/1/2020

Maximum Feed Rate to the Oxidizer (tons/hr):	0.02
Maximum Air Supply Flow Rate (acfm):	15.0
Minimum Air Supply Flow Rate (acfm):	0.1
Oxygen Content in Exhuast (%O2):	5.00
CO Concentration in Exhaust (ppmvd):	0.000001
Total VOC Concentration in Exhaust (ppmvd):	0.000001

09444   Aries Newark Biochar Production Facility   PCP000000 U1 OS6 (Efficiency Table - CD3)
Print Date: 12/1/2020

Pollutant Category	Capture Efficiency (%)	Removal Efficiency (%)	Overall Efficiency (%)
CO	100.00	99.99	99.99
HAP (Total)	100.00	95.00	95.00
NOx	100.00	95.00	95.00
Other (Total)	100.00	90.00	90.00
Pb	100.00	99.00	99.00
PM-10	100.00	99.00	99.00
PM-2.5	100.00	99.00	99.00
SO2	100.00	96.00	96.00
TSP	100.00	99.00	99.00
VOC (Total)	100.00	99.00	99.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS7 (Raw Materials)
Print Date: 12/1/2020

Raw Material	CAS Number	Physical State	Molecular Weight (lbs/lbs-mole)	Does the Material Contain VOC?	Weight Fraction (%)	Vapor Pressure @ 70 deg F (mmHg)	Organic Density	Units
Ash		Sludge	78.000	No				
Carbon		Sludge	12.000	No				
H2O		Sludge	18.000	No				
Hydrogen	01333-74-0	Sludge	1.000	No				
N2		Sludge	14.000	No				
O2		Sludge	16.000	No				
Sand		Solid	60.000	No				
Sulfur		Sludge	32.000	No				

Volume of Gas Discharged from this source (acfm):	22,993.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS7 (Efficiency Table - CD1) Print Date: 12/1/2020			
Pollutant Category	**Capture Efficiency (%)**	**Removal Efficiency (%)**	**Overall Efficiency (%)**
CO	100.00	0.01	1.00
HAP (Total)	100.00	0.01	1.00
NOx	100.00	0.01	1.00
Other (Total)	100.00	0.01	1.00
Pb	100.00	0.01	1.00
PM-10	100.00	99.00	99.00
PM-2.5	100.00	99.00	99.00
SO2	100.00	0.01	1.00
TSP	100.00	99.00	99.00
VOC (Total)	100.00	0.01	1.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS7 (Oxidizer (Thermal) - CD2)
Print Date: 12/1/2020

Maximum Feed Rate to the Oxidizer (tons/hr):	32.36
Maximum Air Supply Flow Rate (acfm):	30000.0
Minimum Air Supply Flow Rate (acfm):	10000.0
Oxygen Content in Exhuast (%O2):	10.60
CO Concentration in Exhaust (ppmvd):	35.000000
Total VOC Concentration in Exhaust (ppmvd):	30.000000

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS7 (Efficiency Table - CD3)
Print Date: 12/1/2020

Pollutant Category	Capture Efficiency (%)	Removal Efficiency (%)	Overall Efficiency (%)
CO	100.00	99.99	99.99
HAP (Total)	100.00	95.00	95.00
NOx	100.00	95.00	95.00
Other (Total)	100.00	90.00	90.00
Pb	100.00	99.00	99.00
PM-10	100.00	99.00	99.00
PM-2.5	100.00	99.00	99.00
SO2	100.00	96.00	96.00
TSP	100.00	99.00	99.00
VOC (Total)	100.00	99.00	99.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS8 (Raw Materials)
Print Date: 12/1/2020

Raw Material	CAS Number	Physical State	Molecular Weight (lbs/lbs-mole)	Does the Material Contain VOC?	Weight Fraction (%)	Vapor Pressure @ 70 deg F (mmHg)	Organic Density	Units
Ash		Sludge	78.000	No				
Carbon		Sludge	12.000	No				
H2O		Sludge	18.000	No				
Hydrogen	01333-74-0	Sludge	1.000	No				
N2		Sludge	14.000	No				
O2		Sludge	16.000	No				
Sand		Solid	60.000	No				
Sulfur		Sludge	32.000	No				

Volume of Gas Discharged from this source (acfm):	22,993.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS8 (Oxidizer (Thermal) - CD2)
Print Date: 12/1/2020

Maximum Feed Rate to the Oxidizer (tons/hr):	32.36
Maximum Air Supply Flow Rate (acfm):	30000.0
Minimum Air Supply Flow Rate (acfm):	10000.0
Oxygen Content in Exhuast (%O2):	10.60
CO Concentration in Exhaust (ppmvd):	35.000000
Total VOC Concentration in Exhaust (ppmvd):	30.000000

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS8 (Efficiency Table - CD3)
Print Date: 12/1/2020

Pollutant Category	Capture Efficiency (%)	Removal Efficiency (%)	Overall Efficiency (%)
CO	100.00	99.99	99.99
HAP (Total)	100.00	95.00	95.00
NOx	100.00	95.00	95.00
Other (Total)	100.00	90.00	90.00
Pb	100.00	99.00	99.00
PM-10	100.00	99.00	99.00
PM-2.5	100.00	99.00	99.00
SO2	100.00	96.00	96.00
TSP	100.00	99.00	99.00
VOC (Total)	100.00	99.00	99.00

Volume of Gas Discharged from this source (acfm):	30.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS9 (Raw Materials)
Print Date: 12/1/2020

Raw Material	CAS Number	Physical State	Molecular Weight (lbs/lbs-mole)	Does the Material Contain VOC?	Weight Fraction (%)	Vapor Pressure @ 70 deg F (mmHg)	Organic Density	Units
Ash		Sludge	78.000	No				
Carbon		Sludge	12.000	No				
H2O		Sludge	18.000	No				
Hydrogen	01333-74-0	Sludge	1.000	No				
N2		Sludge	14.000	No				
O2		Sludge	16.000	No				
Sulfur		Sludge	32.000	No				

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS9 (Oxidizer (Thermal) - CD2)
Print Date: 12/1/2020

Maximum Feed Rate to the Oxidizer (tons/hr):	0.06
Maximum Air Supply Flow Rate (acfm):	30.0
Minimum Air Supply Flow Rate (acfm):	0.1
Oxygen Content in Exhuast (%O2):	0.01
CO Concentration in Exhaust (ppmvd):	0.000010
Total VOC Concentration in Exhaust (ppmvd):	0.000010

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS9 (Efficiency Table - CD3)
Print Date: 12/1/2020

Pollutant Category	Capture Efficiency (%)	Removal Efficiency (%)	Overall Efficiency (%)
CO	100.00	99.99	99.99
HAP (Total)	100.00	95.00	95.00
NOx	100.00	95.00	95.00
Other (Total)	100.00	90.00	90.00
Pb	100.00	99.00	99.00
PM-10	100.00	99.00	99.00
PM-2.5	100.00	99.00	99.00
SO2	100.00	96.00	96.00
TSP	100.00	99.00	99.00
VOC (Total)	100.00	99.00	99.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS10 (Raw Materials)
Print Date: 12/1/2020

Raw Material	CAS Number	Physical State	Molecular Weight (lbs/lbs-mole)	Does the Material Contain VOC?	Weight Fraction (%)	Vapor Pressure @ 70 deg F (mmHg)	Organic Density	Units
Ash		Sludge	78.000	No				
Carbon		Sludge	12.000	No				
H2O		Sludge	18.000	No				
Hydrogen	01333-74-0	Sludge	1.000	No				
N2		Sludge	14.000	No				
O2		Sludge	16.000	No				
Sulfur		Sludge	32.000	No				

Volume of Gas Discharged from this source (acfm):	30.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS10 (Oxidizer (Thermal) - CD2)
Print Date: 12/1/2020

Maximum Feed Rate to the Oxidizer (tons/hr):	0.06
Maximum Air Supply Flow Rate (acfm):	30.0
Minimum Air Supply Flow Rate (acfm):	0.1
Oxygen Content in Exhuast (%O2):	0.01
CO Concentration in Exhaust (ppmvd):	0.000010
Total VOC Concentration in Exhaust (ppmvd):	0.000010

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS10 (Efficiency Table - CD3)
Print Date: 12/1/2020

Pollutant Category	Capture Efficiency (%)	Removal Efficiency (%)	Overall Efficiency (%)
CO	100.00	99.99	99.99
HAP (Total)	100.00	95.00	95.00
NOx	100.00	95.00	95.00
Other (Total)	100.00	90.00	90.00
Pb	100.00	99.00	99.00
PM-10	100.00	99.00	99.00
PM-2.5	100.00	99.00	99.00
SO2	100.00	96.00	96.00
TSP	100.00	99.00	99.00
VOC (Total)	100.00	99.00	99.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS10 (Efficiency Table - CD4)
Print Date: 12/1/2020

Pollutant Category	Capture Efficiency (%)	Removal Efficiency (%)	Overall Efficiency (%)
CO	100.00	0.01	1.00
HAP (Total)	100.00	0.01	1.00
NOx	100.00	0.01	1.00
Other (Total)	100.00	0.01	1.00
Pb	100.00	0.01	1.00
PM-10	100.00	99.00	99.00
PM-2.5	100.00	99.00	99.00
SO2	100.00	0.01	1.00
TSP	100.00	99.00	99.00
VOC (Total)	100.00	0.01	1.00

Volume of Gas Discharged from this source (acfm):	25.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS11 (Raw Materials)
Print Date: 12/1/2020

Raw Material	CAS Number	Physical State	Molecular Weight (lbs/lbs-mole)	Does the Material Contain VOC?	Weight Fraction (%)	Vapor Pressure @ 70 deg F (mmHg)	Organic Density	Units
Ash		Solid	78.000	No				
Carbon		Solid	12.000	No				

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS11 (Efficiency Table - CD5)
Print Date: 12/1/2020

Pollutant Category	Capture Efficiency (%)	Removal Efficiency (%)	Overall Efficiency (%)
CO	100.00	0.01	1.00
HAP (Total)	100.00	0.01	1.00
NOx	100.00	0.01	1.00
Other (Total)	100.00	0.01	1.00
Pb	100.00	0.01	1.00
PM-10	100.00	99.00	99.00
PM-2.5	100.00	99.00	99.00
SO2	100.00	0.01	1.00
TSP	100.00	99.00	99.00
VOC (Total)	100.00	0.01	1.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS12 (Raw Materials)
Print Date: 12/1/2020

Raw Material	CAS Number	Physical State	Molecular Weight (lbs/lbs-mole)	Does the Material Contain VOC?	Weight Fraction (%)	Vapor Pressure @ 70 deg F (mmHg)	Organic Density	Units
Ash		Solid	78.000	No				
Carbon		Solid	12.000	No				

Volume of Gas Discharged from this source (acfm):	25.00

09444 Aries Newark Biochar Production Facility PCP000000 U1 OS12 (Efficiency Table - CD5) Print Date: 12/1/2020			
Pollutant Category	**Capture Efficiency (%)**	**Removal Efficiency (%)**	**Overall Efficiency (%)**
CO	100.00	0.01	1.00
HAP (Total)	100.00	0.01	1.00
NOx	100.00	0.01	1.00
Other (Total)	100.00	0.01	1.00
Pb	100.00	0.01	1.00
PM-10	100.00	99.00	99.00
PM-2.5	100.00	99.00	99.00
SO2	100.00	0.01	1.00
TSP	100.00	99.00	99.00
VOC (Total)	100.00	0.01	1.00

Newark Biochar Production Facility
Air Permit Process Description

(Doc#: NJNE1806-PD-001)
November 30th, 2020
Revision 1

CONFIDENTIAL

REV	DATE	DESCRIPTION	PREPARED	CHECKED	APPROVED
0	08/19/2020	Issued for Review	J Thornton	B Davis	R Kelfkens
1	11/30/2020	Facility Name and description updated	J Thornton	B Davis	R Kelfkens

Approved for release

TABLE OF CONTENTS

EXHIBITS

1. Project Overview

Aries Clean Energy is developing a project in Newark, New Jersey to process biosolids into beneficial biochar, the “Newark Biochar Production Facilty” or the Facility. This Plant will be an Aries Design, Build, Own, Operate, and Maintain (DBOOM) project controlled and managed by Aries and will utilize the Aries Fluidized Bed Gasifier to process and dispose of up to 430 wet tons of domestic wastewater biosolids daily. The project will built on an existing site on the Passaic River.

Aries Clean Energy is an independent, self-controlled company managed by a Board of Directors and Executive Management team and will control the full development, engineering, construction, and operation of the Facility.

The Plant will consist of truck unloading and receiving stations for biosolids, biosolids storage, biosolids dryers, dried biosolids storage, a fluidized bed gasification unit, producer gas combustion and heat recovery system, emissions control system, aqueous ammonia unloading and storage, hydrated lime unloading and storage, and truck loadout facilities for dried biosolids, spent sorbent, and biochar by-products.

The facility will process domestic biosolids of between 70 - 82% moisture from 3rd parties. The 3rd party biosolids will be delivered by truck to the plant for unloading and storage in biosolids bins. Dryers will process the biosolids to produce dried biosolids at 10% moisture content that will primarily be used as fuel for the gasifier. Excess biosolids will be removed by truck for off-site disposal by a 3rd party.

The gasifier will convert the dried biosolids to producer gas and biochar. The producer gas is used as the fuel for a direct fired thermal oxidizer that will provide the thermal energy required to heat air and dry the biosolids in rotary drum dryers. The biochar is a byproduct that consists primarily of ash and a small amount of residual unconverted carbon.

2. Aries Clean Energy Background and Overview

2.1. About Aries Clean Energy

Aries Clean Energy originally commenced business in 2010 under the name of PHG Energy LLC. PHG Energy was funded by the owners of a multi-state Caterpillar dealership to further develop a patented down draft gasification technology already in full commercial use and proven as a viable method of converting wood waste to produce renewable fuel gas for industrial use.

In 2016, Aries Clean Energy constructed the world's largest commercial downdraft gasifier under contract for the City of Lebanon, Tennessee. That facility is owned and operated by the City of Lebanon, TN at its Green Initiative Facility adjacent to the waste water treatment plant. The plant converts a blend of commercial wood waste and biosolids into electric power. With five times the processing throughput and fuel output capacity of earlier generation equipment and competing technologies, the new unit is a major breakthrough in establishing viable and economically feasible, small scale waste processing gasification technology.

In January 2015, PHG purchased assets and intellectual property patents from MaxWest for its fluidized bed gasification technology. MaxWest successfully commercialized and operated its technology at a facility in Sanford, FL between 2012 and 2014. In 2014, the Sanford plant was decommissioned due to the insolvency of MaxWest. The acquisition of the technology opened new waste disposal market opportunities for Aries Clean Energy, including municipal and industrial biosolids disposal.

In March 2017, PHG changed its name to Aries Clean Energy LLC.

Aries Clean Energy's two patented proprietary gasification technologies are suitable for processing and converting a variety of waste streams into usable thermal or electrical energy. Both technologies are applied to realize proven environmental benefits by reducing emissions, as well as simplifying and lowering the cost of waste handling and disposal.

The Aries fluidized bed gasification process for municipal biosolids processing applications has been successfully permitted in two states; New Jersey for the Aries Linden Biosolids Processing Facility and Florida for the project developed by MaxWest.

2.2. Advantages of Aries Technologies

The Aries gasification technology provides a clean, environmentally friendly conversion and reduction of waste into renewable energy and biochar in a thermochemical process.

The advantages of Aries gasification of waste include:
- Reduction in usage of fossil fuels;
- Reduction of greenhouse gas emissions;
- Reduces or eliminates landfill of wastes;
- Safe and cost-effective destruction of biosolids;
- Flexibility in plant size, capabilities ranging from 25 tons/day or 100 tons/day;
- Flexibility in energy offtake through the production of producer gas and thermal energy which can be captured and used as renewable energy;
- Production of biochar, a soil amendment for agricultural or industrial use;
- Predictable financial costs and returns.

2.3. Past Projects Utilizing the Aries Fluidized Bed Gasifier Process

The fluidized bed gasifier process proposed for the Facility was permitted for the Linden Biosolids Processing Plant under PI#42614 and PCP#200002 in July 2019. The facility utilizes state of the art emissions control and the project to be constructed in Newark NJ will match this. The project will be operationally identical to the Linden project which is due to complete construction in early 2021.

The fluidized bed gasifier was also permitted and constructed by MaxWest in Sanford, FL with an approved air permit for operation (FDEP Permit No. 1170409-001-AC). The stack emissions test report for this facility is available and is submitted as Exhibit B to this document.

3. Process Overview

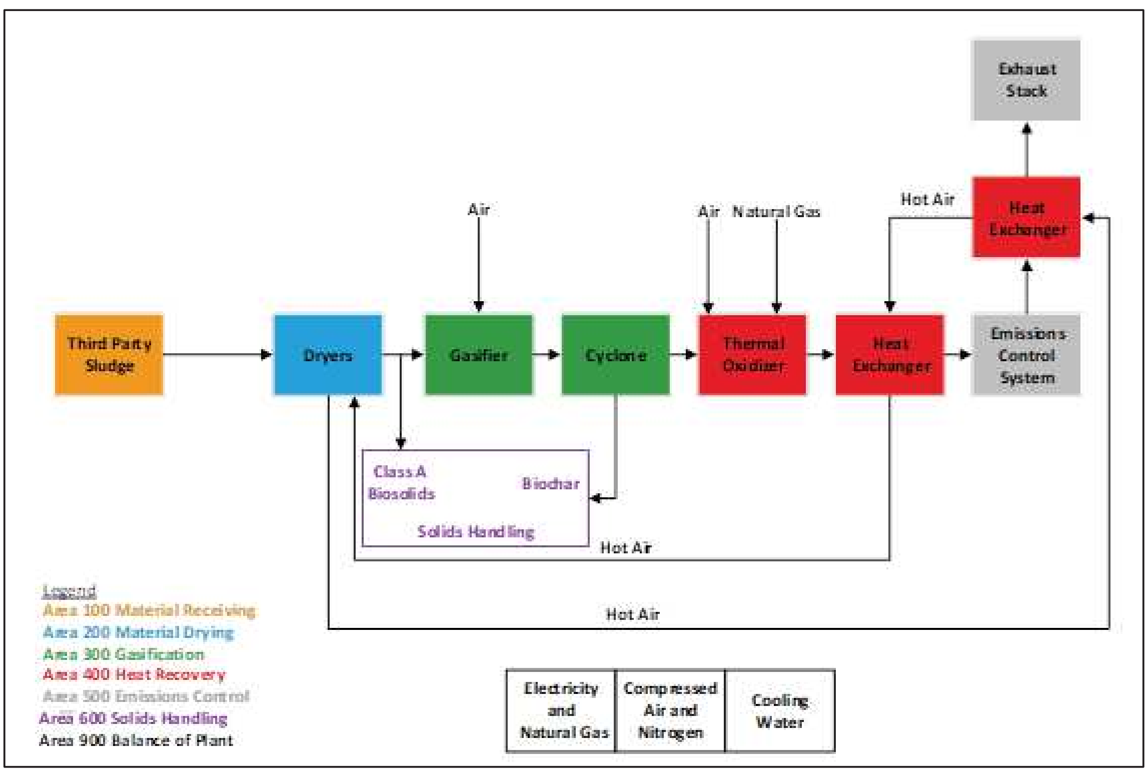
The Facility integrates the Aries proprietary fluidized bed gasification system with a conventional biosolids drying system. The dried biosolids from the drying system are gasified, converting the biosolids to producer gas and a residual inert biochar.

The plant, comprised of discrete processing units, is divided into the following functional process areas as listed below and depicted in Figure 3.1:

Area 100 – Material Receiving
Area 200 – Material Handling and Drying
Area 300 – Gasification
Area 400 – Heat Recovery
Area 500 – Emissions Control
Area 700 – Solids Handling
Area 800 – Civil, Structural, and Architectural
Area 900 – Balance of Plant

The process areas and unit processes will be described in the sections that follow and include the supporting data and calculations for the application.

Figure 3.1
Facility Simplified Block Diagram



4. Functional Process Flow Description by Area

4.1. Material Receiving (Area 100)

4.1.1. General Information

The Facility will receive up to 430 tons/day of 70% to 82% domestic untreated sewage biosolids. The biosolids will be delivered to the site by truck with back dump truck trailers each with a capacity of 20 to 25 tons. The total traffic for biosolids delivery will be 16 - 20 trucks per day. Trucks will enter at the main entry gate at a rate of approximately 2 trucks per hour during a 12-hour workday, 7 days a week.

Each delivery is scheduled by Aries based on operational needs. Information is recorded by the operator on a log sheet that includes the facility generator and date and time truck entered the facility. Samples will be taken per the sampling plan and will be held until they have been analyzed by the lab. Samples will be disposed of properly once the lab analysis is returned with no abnormalities in the analysis report. The sampling and reporting procedures will be included in the NJPDES permit requirements.

4.1.2. Biosolids Composition

The expected characteristics of the biosolids received are shown in the Table 4.1.

Table 4.1
Typical Domestic Biosolids Composition[1]

Description	Concentration Dry Basis (mg/kg biosolids)	Concentration Dry Basis (lbs/ton biosolids)
Total Solids (% by wt)	25.7	0.514
pH (standard Units)	7.6	7.6
Total VOC's[2]	698,000	1395
Total Nitrogen (TKN)	55,100	110
Nitrate-Nitrogen	8.0	0.016
Ammonia-Nitrogen	8,036	16
Total Sulfur	18,200	36
Oxygen	181,000	362
Hydrogen	55,900	112
Carbon	387,300	775
Total Ash	298,900	597
Ash Content (Major Components)		
Phosphorus	N/A	N/A
Arsenic	1.9	0.0038
Copper	550.8	1.1
Molybdenum	17.8	0.0356
Zinc	944.0	1.9

Potassium	1,062.9	2.1
Cadmium	1.8	0.0036
Lead	76.8	0.2
Nickel	29.6	0.1
Calcium	26,784.6	53.6
Mercury	0.9	0.0018
Selenium	4.7	0.0094

Notes:
1. From representative samples and published data. Received biosolids should be of a similar nature.
2. Because VOCs are emitted, captured, converted, and destroyed in the process, specifically in the gasification process, the VOC quantities listed in this table cannot be used to validate the emissions calculations contained in Exhibit E.

4.1.3. Biosolids Unloading

The receiving bins will be located directly above the storage bins. The trucks will drive over one of two driveways, as directed, to offload (dump out) the biosolids into a newly constructed underground storage vault containing two (2) bins nominally 650 tons each. The receiving bins will be located above grade while the storage bins and all associated equipment (pumps, live bottoms, etc.) will be below grade or will be slightly above grade with a ramp to the entrance of the receiving bin. The receiving bins will need to be at least 12 feet wide to accommodate the dump trucks.

The truck contents are emptied continuously into the receiving bins in a 15 to 20-minute period. Once the truck is emptied, the trailer lowers, and the bin is simultaneously closed. Each truck can be positioned, offloaded and depart from the site in less than 45 minutes and each receiving bin is only opened 8 to 10 times each.

4.1.4. Odor Controls

The receiving and storage bins will be enclosed in a building that will be under negative pressure in order to prevent odors from escaping. The waste biosolids to be processed by the Facility is received in closed trailer dump trucks. The trucks are unloaded (dumped) into receiving bins and are only opened for the duration that it takes to unload a truck, i.e. estimated to be 15 to 20 minutes each hour. Once the truck is unloaded, the receiving bins are immediately closed, and the odors are contained.

Vents from the bins and the process are routed to and discharge into its own thermal oxidizer and treated through combustion. Mal odors that might be present because of the biosolids handling should be eliminated or mitigated to a level that is not offensive.

4.1.5. Biosolids Emissions Calculations

Emissions calculations for the time the biosolids receiving bins are open are provided in Section 7 of this document.

4.2. Material Handling and Drying (Area 200)

4.2.1. Material Handling (Biosolids Transfer and Storage)

Receiving/Storage Tanks #1 and #2 are completely enclosed tanks with sealed connections for receiving incoming biosolids, a nitrogen purge line, a vented line, and a sealed bottom. Negative air pressure is created to capture odors and nitrogen used to displace air (oxygen) to prevent build-up of gases. The odors, displaced gases, and nitrogen are vented to the thermal oxidizer described in Section 4.4.1.

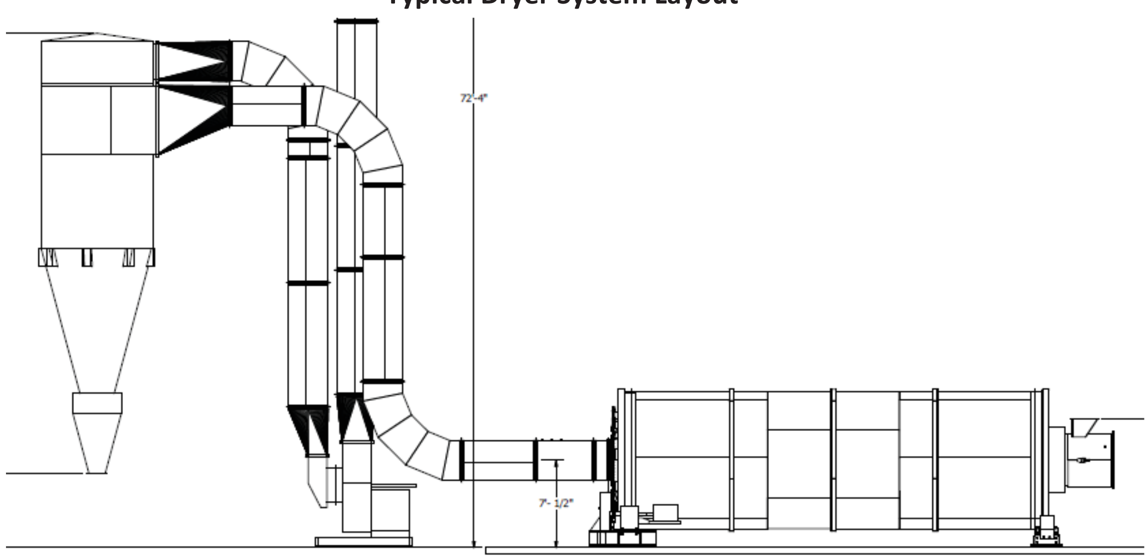
Each storage tank has a working capacity of approximately 650 tons.

Throughout the day, biosolids is transferred from Storage Tanks #1 and #2 via pumps and enclosed pipe to Pug Mill #1 and Pug Mill #2.

The drying plant consists of two 50% dryer trains each capable of processing 225 tons/day of 22% moisture content biosolids. The biosolids from the storage tanks is sent to the pug mills. The pug mill provides mixing of the biosolids to homogenize the feed into the dryer. Each dryer is equipped with a cyclone, Dryer Cyclone #1 and Dryer Cyclone #2, to separate the dried solids from the saturated air stream. Heat for drying is supplied by heating the air separated and recovered from the dryer cyclone as described in the heat recovery section of 6.5.3.

The air streams from the two cyclones are combined, fresh air added, and then recycled through successive gas-to-gas heat recovery exchangers to heat up the air to the required dryer inlet temperature through exchange with combustion flue gas from the thermal oxidizer. This heat is used to dry the biosolids and produce a total of approximately 100 tons/day of dried biosolids with 10% moisture content.

Figure 4.2
Typical Dryer System Layout



The dried solids from the cyclone are gravity transferred to a biosolids storage bin. Each storage bin is also equipped with vents and inert gas (nitrogen) injection systems to provide for safety from self-heating/combustion and pressure relief as required of this type of storage. Locking valves will be used during conveyance into and out of the dried biosolids storage bin to ensure air is not introduced into the storage bin to avoid potential sources for combustion.

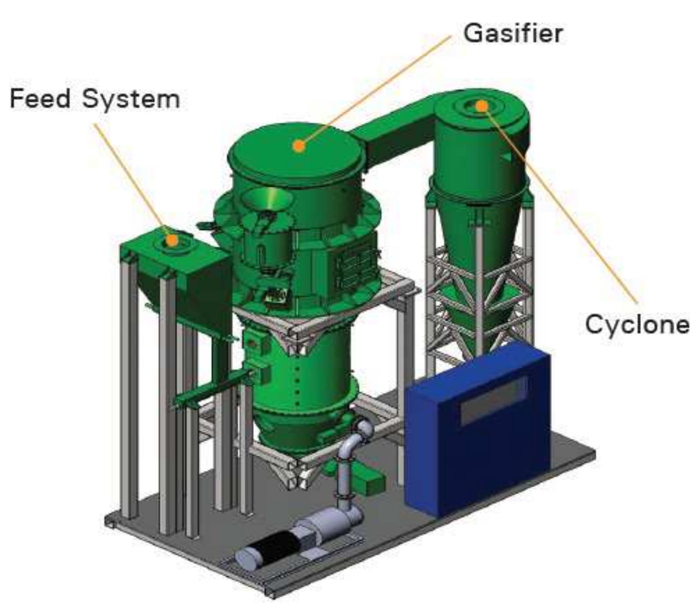
A 3rd party patented advanced drying will be used to cost-effectively produce high yields of dry biosolids. The biosolids feed rate to the dryers will be controlled automatically through the dryer control panel to match the selected moisture content of the dried or final product. The design features a highly automated software system to manage the re-circulation of the air stream, heat recovery system, and thermal oxidizer. This system is the most advanced drying system available. Control of the desired dryness and biosolids yield is automated and automatically adjusts: 1) air volume, 2) air temperature, and 3) drum speed.

An automated adjustable bypass system is used to feed dried biosolids from the cyclone to a loadout bin. The bypass is controlled to allow no flow of dried biosolids to the loadout bin or can be set to control a specific rate of flow depending on the operational requirements of the plant.

4.3. Gasification (Area 300)

The gasification system consists of the Aries proprietary fluidized bed gasifier, and a cyclone attached to it depicted in Figure 4.3. The gasifier is a refractory lined steel vessel in which the gasification reactions take place essentially at ambient pressure.

Figure 4.3
Model of Aries Fluidized Bed Gasification System



The gasifier utilizes quartz sand as the inert bed material. Air is used as fluidization medium and injected into the bottom of the gasifier to fluidize the bed of sand. The gasifier is started up by fluidizing and heating the bed of sand with natural gas (minimum of 900°F) before biosolids are introduced. The natural gas is combusted in the start-up burner. The startup burner is used solely during plant startup.

Once the gasifier sand bed reaches minimum temperature, dried biosolids are introduced into the fluidized bed from the Gasifier Feed Bins by means of feed augers at four feed points equally spaced around the gasifier. The volume of air is about one fourth of the amount of air that would be needed to fully oxidize the biosolids. The oxygen in this small amount of air reacts with the biosolids and releases heat which provides the energy for the gasification reactions to promulgate in a fuel rich, oxygen-starved environment. Gasification reactions start occurring at 900°F converting the biosolids carbonaceous material and VOCs to gas. The release of exothermic heat by the gasification reactions to the bed further increases the temperature to a normal operating temperature controlled at about 1,250°F. During this process the start-up system is switched over to air supply by the main ambient air blower. The biosolids are converted to methane, carbon monoxide, hydrogen, and other minor species to form a low energy fuel gas (synthetic gas or syngas).

The gasifier has the capability to remove coarse biochar at the bottom of the gasifier through a residue auger. The fine residual solids, a biochar consisting mostly of ash and unconverted carbon, is elutriated through the top of the gasifier and captured in the gasifier cyclone. The fine biochar exits the bottom of the cyclone and is combined with the biochar removed from the gasifier on a discharge cooling screw conveyor and routed to the Biochar Loadout Bin. Cooling water from a cooling tower is used to cool the biochar. The gasifier can also discharge biochar at the bottom of the gasifier if needed for level control and/or maintenance purposes by way of the Gasifier Biochar Residue Auger.

The key variables that affect the efficiency of gasifier operation include feedstock properties (particle size, moisture content, ash fusion temperatures, etc.), design of the feeding system, and fluidization parameters (fuel-to-air ratio, fluidization velocity, inert bed material, etc.).

The temperature is maintained at 1250°F to minimize potential clinker or agglomeration formation by alkali material in the biosolids. Biosolids typically contain certain constituents which can lead to the formation of low melting point eutectics in the bed. Fluidized bed gasification has certain advantages when processing this type of material. These advantages include a well-mixed bed with a uniform temperature and the capability to control the bed temperature to a level that is less than the melting point of the potential eutectics which is about 1350°F.

In the gasification unit, the dried biosolids are converted to a low heating value producer gas and biochar. The main gasification reactions are as follows:

Oxidation:	$C+O_2 \rightarrow CO_2$
Steam reforming:	$C+H_2O \rightarrow CO+H_2$
Boudouard Equilibrium:	$CO_2+C \rightarrow 2CO$
Water Gas Shift reaction:	$H_2O+CO \rightarrow H_2+CO_2$

Methanation: $C+2H_2 \rightarrow CH_4$

The main constituents of the producer gas are H_2, CO, CH_4, CO_2, and N_2, with trace amounts of other hydrocarbons, tars, and particulate matter. The resulting producer gas typically has a lower heating value (LHV) in the range of 120-150 Btu/scf. The producer gas flows to the thermal oxidizer where it is combusted to produce the required heat source to heat the air for the dryers.

4.4. Heat Recovery System (Area 400)

4.4.1. Thermal Oxidizer

The project will use a direct fired thermal oxidizer. The thermal oxidizer is a refractory lined steel cylinder with ports for the admission of air to promote the homogenous blending of the producer gas and vent gases with air taking the resultant mass to combustion. The thermal oxidizer is equipped with a dual burner with producer gas and natural gas injection ports. The thermal oxidizer can operate with either producer gas or natural gas and can co-fire both gases. The thermal oxidizer operation allows proper mixing of the gases and sufficient residence time and temperature to destroy VOCs, CO, and odor causing contaminants.

Figure 4.4
Model of a Thermal Oxidizer

The heat from the oxidized gases is used in the heat recovery exchangers to heat air for the dryers while also cooling the flue gas prior to it entering the emissions control unit. The flue gases are all contained and exhausted to the stack assisted by an induction fan to ensure exhaust flow.

Air volume into the thermal oxidizer is controlled through the oxidizer fan system. An oxygen sensor is used to ensure that sufficient air is being added in the thermal oxidizer to facilitate control to complete combustion. Temperature sensors are mounted at the end of the thermal oxidizer to control the volume of air required to maintain a pre-set exit temperature of 1800°F.

The feed to the thermal oxidizer also includes the purge streams from the dryer as well the vents from the biosolids handling equipment.

4.4.1.1. Thermal Oxidizer – Normal Operations with Gasifier

The thermal oxidizer will normally operate in the steady state utilizing producer gas from the Gasifier as a fuel source.

4.4.1.2. Thermal Oxidizer – Maintenance Operations – Gasifier Down

When the gasifier is not in operation for any reason, and producer gas is not available, the thermal oxidizer will operate utilizing natural gas.

4.4.2. Heat Exchange/Hot Air

The heat recovery system consists of two high efficiency gas to gas heat exchangers in series. The heat exchangers are used to recover the thermal energy from the flue gas produced in the thermal oxidizer. By recovering the heat from the flue gas in the heat exchangers, temperature in the flue gas is regulated and optimized for the emissions control system. This ensures optimal temperature for the removal of NOx.

The saturated air stream is drawn out from each cyclone with air blowers and processed in the condensers, where the moisture is cooled and condensed from the air stream through an indirect heat exchange process with cooling water supplied from and returned to the cooling tower.

Heated flue gas from the thermal oxidizer is routed through the first air-to-flue gas heat exchanger, Heat Exchanger #1 to heat up the air that has been pre-heated in the second air-to-flue gas heat exchanger, Heat Exchanger #2.

The cooled flue gas from Heat Exchanger #1 is then routed through the emissions control system then Heat Exchanger #2 before exhausting the cooled flue gas through the stack. The condensate is collected in a holding tank and then pumped to an existing process water drain. The process drain is routed to the sewer.

4.5. Emissions Control (Area 500)

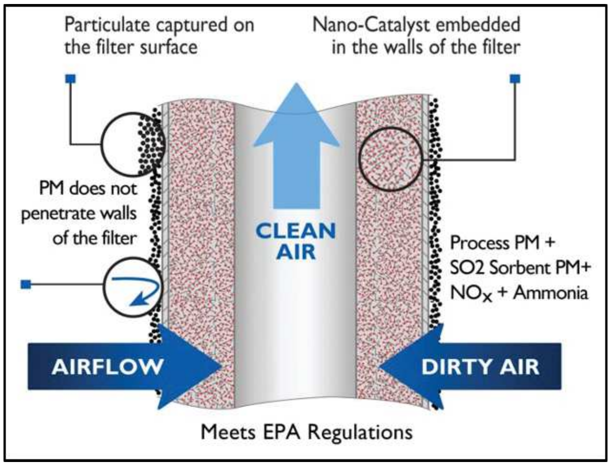
An emission control system will be installed to reduce the NOx, SOx and HCl, and particulate emissions. The emission control equipment selected for the project eliminates 99% of particulate matter (PM), greater than 95% NOx, and greater than 96% SOx from the flue gas. The system consists of an enclosed Selective Catalytic Reduction, dry sorbent injection, and a ceramic filter house.

The selected supplier for the Emissions Control System is Tri-Mer Corporation (TMC) who will provide their proprietary state of the art UltraCat Catalytic Filter (UCF) System.

4.5.1. Approach

TMC is proposing to utilize high temperature lightweight ceramic filters impregnated with catalyst as the primary method of treating the exhaust gas. The UltraCat filters start as a slurry of refractory fibers and are "injection molded" into tube shapes that are 10 feet long and six inches across. The filters are very lightweight, approximately 90% open, with very low pressure drop. They are robust, resistant to mechanical and thermal shock, and self-supporting without any filter cages.

Figure 4.5
UltraCat Ceramic Filter



The processes used by various manufacturers to make ceramic filters are different in important ways and produce distinctly different products. With the UltraCat process (injection molding), small pores are created on the outside of the filters, preventing penetration of particulates into the filter wall, and enhancing easy release of the particulate during the cleaning cycle. Other brands of ceramic filters are usually vacuum formed, which produce larger pores on the outer surface. This has been shown to seriously affect the ability to effectively clean the filters, and consequently increase operating pressure drop and reduce the filter life.

The UltraCat Catalytic filters have nano-bits of catalyst embedded in their 3/4-inch thick walls to facilitate the selective catalytic reduction (SCR) of NOx by NH_3. The nano-catalyst offers a 6X better utilization of the catalyst than for conventional block catalyst SCR reactors. In the filters, contact time between the gases and catalyst is not restricted by the required diffusion of the gases to the coated walls of the block reactor gas channels. This greater utilization of the catalyst allows good performance at lower temperatures with reasonable catalyst volumes and differential pressure.

The performance of all catalysts can be severely compromised by either physical blinding from particulates or chemical deactivation by either reactive particulates or gases. With the TMC UCF, particulate is captured on the surface of the filters. The nano-catalyst is completely protected inside the filter, eliminating the particulate-type interactions and extending the catalyst life.

High performance hydrated lime will be injected upstream of the filters to control SO_2 and any other acid gases present. Ammonia will also be injected upstream and the interaction with the catalyst embedded in the filters will convert a high percentage of the NO_X emissions to harmless nitrogen gas and water vapor, with very low ammonia slip.

Advantages of the modularized UltraCat ceramic filter approach include:

- Performance - High removal of pollutants, superior overall.
- Redundancy - Built into the modular approach.
- Simplicity - PM, SOx, and NOx are treated in the same unit.
- Maintenance - Fewer moving parts, less corrosion, no high voltage electrical.

TMC fabricates the filter housings in three sections and pre-assembles them in the factory for fit and completeness. The sections are shipped to the job site on standard flatbed trucks where they are quickly re-assembled by a dedicated TMC team. This minimizes problems in the field and allows for full control of the schedule by TMC. Seasoned equipment professionals know that the common approach of assembling an "erector set of parts and pieces" at the site is a high-risk proposition. Often the pieces are coming from various subcontractors and physical locations. The TMC modularized and pre-assembled strategy avoids much of this complexity and confusion, thus mitigating risk both in terms of cost and schedule.

The TMC scope consists of the following major items:

- Filter housings with filters and all hardware and software required for operations;
- Sorbent injection system with sorbent storage system;
- Particulate matter handling and capture system;
- Aqueous ammonia injection system and 10,000-gallon storage tank;
- Interconnecting ductwork from tie-in point to UCF units;
- Continuous Emissions Monitoring System (CEMS);
- Controls system that integrates monitoring and control of all components and systems listed above;
- Supervision during construction and startup services.

4.5.2. Emissions Control System Description

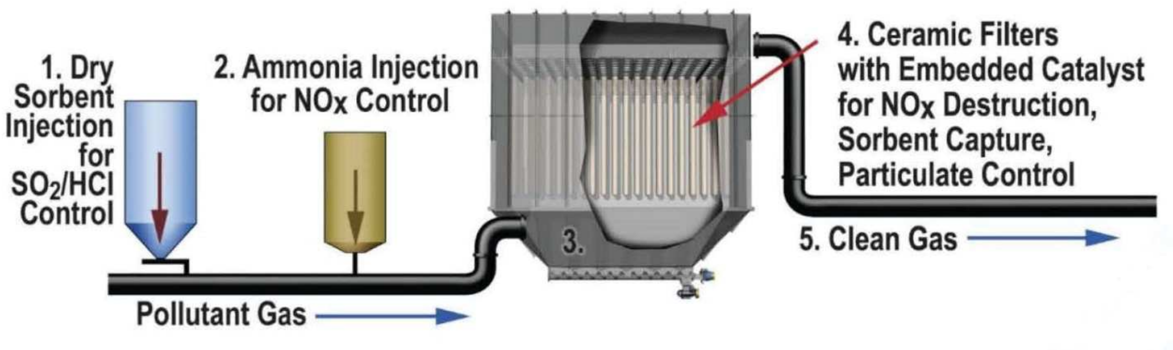
Hydrated lime sorbent is delivered by truck to the site and unloaded into a sorbent storage silo. Aqueous ammonia is delivered by truck in a 19% solution for storage in a 10,000-gallon tank.

Hydrated lime sorbent and aqueous ammonia are injected into the flue gas stream as it flows into the ceramic filter house for SOx and NOx reduction. The hydrated lime also acts to attract positively charged Chromium VI that may be present, thereby removing it from the flue gas stream. The injection rate of dry sorbent is controlled based on the specified outlet emission limit.

The ammonia injection is accomplished through the use of air atomizing nozzles. The rate is controlled by measuring inlet mass rate of NOx. The rate is used to calculate the aqueous ammonia injection rate that is based on specified reduction percentage. Ammonia slip is continuously measured and may be used as a means of fine tuning the injection rate.

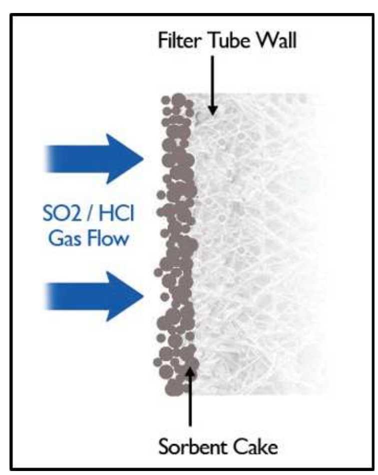
The SCR process uses a 19% aqueous ammonia solution as a reactant to remove NOx. NOx emissions are further reduced with some control of the gas temperatures and vanadium pentoxide as a catalyst embedded in the ceramic filters.

Figure 4.6
Process Flow Tri-Mer Emissions Control System



The combined exhaust gas containing the required levels of dry sorbent and aqua ammonia flows to the inlet plenum of the UCF system. The retention within the duct provides vaporization of aqua ammonia, mixing of sorbent and ammonia gas with the process gas, and the first step of acid gas reaction with the dry sorbent. The gas is then split across the filter housings within which it flows through the ceramic filter elements. The particulate matter (PM) is removed, the acid gas is more fully reacted by the sorbent cake that forms on the filters, and the NOx and ammonia are converted to nitrogen and water vapor by contact with the catalyst contained within the filter element walls.

Figure 4.7
Filter Sorbent Cake



An induction fan installed on the downstream side of the filter house provides for a continuous induced flow of air within the flue gas duct work and ancillary emissions control equipment. The exhaust or discharge side of the induction fan is connected directly to the system exhaust stack.

The exhaust will exit the stack and is designed per the Environmental Protection Agency's (EPA) recommendations on Good Engineering Practice (GEP) for air dispersion of the exhausted air and gas.

Process solids (spent sorbent material) generated by the system are collected in a long hopper of each filter housing and conveyed with a rotary auger to the end of the hopper where they are discharged through a double flap valve and collected in a closed container.

4.6. Solids Handling (Area 700)

4.6.1. Dried Biosolids Loadout

In the event that the gasifier is offline or during turn down conditions, the dried biosolids can be stored in a biosolids storage bin. The truck loadout facility for the dried biosolids is designed for normal operating conditions to loadout and remove dried biosolids every 2nd day. During shutdown of the gasifier, the system will accommodate loadout of up to 100 tons per day, the maximum dried biosolids output of the dryers.

The dried biosolids do not contain any hazardous materials, raw septage, fats, oils, or greases and will meet the requirements of the US EPA Section 40 Part 503.

The unloading station for the dried biosolids includes the biosolids storage bin, and an induction fan. The induction fan provides suction through a pipe that surrounds the unloading arm from the bin to the truck and the flow is directed to the thermal oxidizer in the Plant.

Worst case emissions from the Dried Biosolids Loadout occurs when the gasifier is not in operation and 100 tons/day of dried solids must be loaded out for disposal by truck off-site, out of state. A calculation of the PM10 emissions is provided in Section 7 of this document.

4.6.2. Biochar Loadout

The Biochar produced by the gasifier is stored in a Biochar Storage Tank. The expected or normal production of biochar is approximately 25 tons/day and the biochar is loaded out once each day for disposal off-site.

The expected biochar characteristics are provided in the Table 4.3.

Table 4.3
Biochar Characteristics

Proximate Analysis	% by Weight
Fixed Carbon	5-10%
Ash	90-95%

Worst case emissions from the Biochar Loadout occurs when the gasifier is in operation and 25 tons/day of dried solids must be loaded out for disposal by truck off-site. A calculation of the PM10 emissions is provided in Section 7 of this document

4.7. Balance of Plant (Area 900)

4.7.1. Electricity

The site will require an estimated 2,000 kVA of connected load with about 95% of the connected load operating 24 hours a day and 7 days a week during normal, steady state operations. A new electrical utility service will be provided to a site step down transformer that will provide 480VAC, 3 phase, 60 hertz electrical power for distribution to the Biosolids Processing Plant loads.

4.7.2. Natural Gas

Natural gas will be supplied to the site by local utility on a metered service with the pressure and flow rate to be determined by the utility. If required, a booster station will be installed to maintain the pressure and flow to the requirements for the plant under normal operating conditions of the plant. Natural gas is used during the startup of the plant after any outage and when the gasifier is not in operation. The maximum flow rate required is estimated to be 60 MMBTUs per hour at 10 psig pressure.

4.7.3. Cooling Water and Heat Rejection

A new cooling tower basin will be constructed and a cooling tower and cooling water supply and return pumps installed.

Cooling water for processes and heat rejection is provided by the cooling tower. Cooling water is used in the process for cooling screw conveyors and hot materials such as the biochar and ash, in the condensers for the dryers to remove moisture from the hot dryer air, and for a few other minor uses.

4.7.4. Air and Compressed Air

Compressed air will be required for the process to support instrument purges, pneumatic valve operations, and back pulsing the emissions control baghouse to remove spent lime and particulate matter. The instrument air system will provide 60 psig instrument quality dry air with a dew point of -40°F.

4.7.5. Nitrogen

A 40 scfm nitrogen generator to produce 95% nitrogen will be installed to provide inert gas for purging and fill of spaces that might otherwise become combustible if the oxygen is not displaced.

5. Operating Scenarios

As directed by NJDEP there are twelve identified operating scenarios for the plant as entered in to the NJDEP Radius application.

- **Operating Scenario 1 and 2 (OS1 And OS2) –** Receiving Biosolids venting to Thermal Oxidizer CD2 to PT1

- **Operating Scenario 3 and 4 (OS3 and OS4) –** Biosolids Storage Bins venting to Thermal Oxidizer CD2 to PT1.
- **Operating Scenario 5 and 6 (OS5 and OS6) –** Gasifier Feed Bins Venting to Thermal Oxidizer CD2 through emissions control CD3 to PT1.
- **Operating Scenario 7 (OS7) –** Normal Operation, with gasifier. Producer gas through cyclone CD1 to thermal oxidizer CD2 through emissions control CD3 to PT1.

The steady state normal operation of the plant is based on receiving 430 tons per day of domestic wastewater biosolids with a moisture content of 78%, with the gasifier in operation and converting 100 tons per day of the available dried biosolids at 10% moisture. In OS7, the thermal oxidizer ***combusts only producer gas*** **(<u>no natural gas</u>)** to satisfy the dryer thermal energy requirements.

- **Operating Scenario 8 (OS8) Maintenance -** without gasifier. Combusted natural gas in thermal oxidizer CD2 through emissions control CD3 to PT1.

Essentially, the normal operations in OS8 conditions are identical to OS7, except that the gasifier is not in operation. **This is a maintenance case only and will not be the normal operations of the plant.** In this scenario, the 100 tons per day of dried biosolids would be removed by truck for sale/disposal. In OS8, the thermal oxidizer ***combusts natural gas only*** **(<u>no producer gas</u>)** to provide the necessary heat to the dryers.

- **Operating Scenario 9 (OS9) –** Charging Biosolids Bin and Venting to Thermal Oxidizer CD2 through emissions control CD3 to PT1.
- **Operating Scenario 10 (OS10) –** Biosolids loadout to truck fugitive emissions collected by CD4 and Venting to Thermal Oxidizer CD2 through emissions control CD3 to PT1.
- **Operating Scenario 11 (OS11) –** Charging Biochar Bin and Venting to Filter CD5.
- **Operating Scenario 12 (OS12) –** Biochar loadout to truck fugitive emissions collected by filter CD5.

6. Air Permit Regulatory Discussion

6.1. State Requirements

The facility will include sources for which the Potential to Emit (PTE) for all criteria pollutants is less than major source thresholds. The facility is subject to the permitting procedures and regulatory requirements of N.J.A.C. 7:27-8.

6.2. Federal Requirements

The following federal regulations that have been reviewed as part of this permit application are as follows:

40 CFR 60 Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

40 CFR 60 Subpart LLLL – Standards of Performance for New Sewage Sludge Incineration Units

40 CFR 61 Subpart E – National Emission Standard for Mercury

40 CFR 63 – National Emission Standards for Hazardous Air Pollutants (NESHAP)

40 CFR 60 Subpart Dc – Standards of Performance for Small Industrial-Commercial-Institutional Steam Generating Units

6.2.1. 40 CFR 60 Subpart DC Applicability

The Thermal Oxidizer will be utilized as a control device for the destruction of CO and VOC as described in Section 4.5.1 of this document. The system does not meet the definition of a Steam Generating Unit which is defined as a device that combusts any fuel and produces steam or heats water or heats any heat transfer medium, and therefore 40 CFR 60 Subpart Dc is not applicable. In addition, for purposes of SOTA discussion below, the Thermal Oxidizer also does not meet the definition of a process heater.

6.2.2. 40 CFR 60 Subpart LLLL Applicability Determination

As per EPA letter, dated December 19, 2013, and attached to this document as Attachment F, the source does not meet the definition of a Sewage Sludge Incinerator (SSI) found in 40 CFR §60.5250. The same definition for SSI is found in 40 CFR §60.4930 and therefore the facility is not subject to the requirements of 40 CFR Subpart LLLL.

6.2.3. 40 CFR 61 Subpart E Applicability Determination

The facility does not meet the applicability found in 40 CFR 61.50, in that the facility does not meet the definition of 'biosolids dryer,' as per 40 CFR 61.51(m). Combustion gases, whether natural gas or producer gas from the gasifier, are consumed in the thermal oxidizer and gas to gas (hot air to hot air) heat exchangers are used to heat the air used in the dryer to dry the biosolids. This would be indirect use of combustion to dry the biosolids not direct.

6.2.4. 40 CFR 63 – National Emission Standards for Hazardous Air Pollutants

The US EPA has established National Emission Standards for Hazardous Air Pollutants (NESHAPS) at 40 CFR Part 63 for a variety of source categories located at major sources of HAP emissions.

A major source of HAP emissions is a facility with the potential to emit any single HAP at a rate of 10 tons or more per year or any combination of HAPS at a rate of 25 tons or more per year. The Facility will not exceed either of the HAP major source thresholds. The Facility will not be a major source of HAPS and is therefore exempt from the NESHAP requirements.

6.3. State of the Art (SOTA)

N.J.A. C. 7:27-8.12(a) requires documentation of SOTA for the construction of equipment and a control apparatus which is a significant source that meets the following criteria:

- The equipment and control apparatus have a potential to emit any HAP at a rate equal to or greater than the SOTA Threshold at N.J.A.C. 7:27-17.9(b); or
- The equipment and control apparatus have a potential to emit any other air contaminant or category of air contaminant, except CO_2, at a rate equal to or greater than the SOTA threshold in Appendix 1, Table A.

Documentation of SOTA is only required for sources that meet the above criteria, and for each source, SOTA is only required for the air contaminants for which it has potential emissions above the thresholds. The potential emissions from a source, for the purposes of determining whether it is subject to SOTA, is determined considering emissions controls, and must include any fugitive emissions released from the equipment, but not fugitive emissions released from the general infrastructure of the Facility.

It has been determined that the facility is not subject to SOTA for Municipal Wastewater/Biosolids Handling and Treatment Systems as this manual is related to wastewater treatment operations. As such, SOTA is applicable for VOC, Nitrogen Oxides (NOx), Sulfur Oxides (SOx) and Particulate Matter (TSP, PM-10 and PM.2.5) on a Case-by-Case SOTA analysis because the potential emissions will be greater than 5 tons per year for these pollutants. A SOTA analysis is provided. There are no HAPs that are above the reporting threshold and therefore HAPs are not subject to SOTA but they are also addressed below.

6.3.1. Volatile Organic Compounds

Section 3.9 of the SOTA Manual for VOC Emissions from Municipal Wastewater/Biosolids Handling and Treatment Systems, lists the performance standard for VOC control from Thermal Oxidizers as 98% removal. The Thermal Oxidizer for the facility will achieve removal efficiency greater than 99% and is therefore considered SOTA for this source. As a Thermal Oxidizer is the top-rated control technology for VOC's, the Department's top down evaluation of control devices does not require the analysis of lesser efficiency control devices.

6.3.2. Nitrogen Oxides (NOx) - Selective Catalytic Reduction (SCR)

The NJDEP SOTA Manual does not list NOx control technologies or emission limits for Municipal Wastewater/Biosolids Handling and Treatment Systems. However, Aries has chosen Selective Catalytic Reduction for the control of Nitrogen Oxides at the facility. It is well established that SCR would be considered Best Available Control Technology (BACT) for control of NOx through the following control mechanisms. As SCR is the top rated control technology for NOx, the Department's top down evaluation of control devices does not require the analysis of lesser efficiency control devices.

The SCR system is a method for converting NO_X generated from the Biosolids Processing exhaust stream to diatomic nitrogen and water by reacting with NH_3 in the presence of a catalyst. The catalyst for the system chose in Vanadium Pentoxide. NH_3 is vaporized and injected in the flue gas upstream of the catalyst, which, when passing over the catalyst, results in the following dominant chemical reactions.

$$4NO + 4NH_3 + O_2 \rightarrow 4N_2 + 6H_2O$$

$$2NO_2 + 4NH_3 + O_2 \rightarrow 3N_2 + 6H_2O$$

The operating temperature and the flue gas properties are critical to both the performance and life of the catalyst. In this application, modules of the catalyst are installed downstream of the thermal oxidizer. The typical operational temperature range for base-metal catalysts is 600°F to 800°F. In an application where no heat recovery is accomplished, high temperature catalysts (1100°F) may be used. The key technical and economic issues are the performance and life of the catalyst.

Environmental impacts associated with SCR are emissions and storage of NH_3 and catalyst disposal. Low levels of NH_3 slip are to be considered in assessment of environmental impacts. Throughout the life span of the catalyst, maximum NH_3 slip will not exceed 10 ppm. SCR can also result in some additional PM_{10} emissions in the form of ammonium bisulfate compounds, which typically increase as ammonia slip is reduced by adding catalyst. By balancing the allowable ammonia slip and the required catalyst necessary to achieve the required level of NO_X control, the SCR system's contribution to the potential PM_{10} emissions of the proposed Facility is negligible.

This control technique is a well-demonstrated technology. This technology will be utilized for the Facility for the control of NO_X emissions and is considered SOTA for this source.

6.3.3. Sulfur Oxides (SOx):

Please see Aries Linden Top-down SOTA Analysis which Aries performed as part of the Linden Biosolids Processing Plant permit application. The SOTA technology that was utilized there will also be applied here with the same control efficiencies. See Exhibit K for the Analysis.

6.3.4. Particulate Matter (TSP, PM-10, PM-2.5)

The NJDEP SOTA Manual does not list PM control technologies or emission limits for Municipal Wastewater/Biosolids Handling and Treatment Systems. The ceramic cartridge filter described in Section 4.5 would be considered BACT for this source. As the ceramic cartridge filter "baghouse" is the top-rated control technology for particulates, the Department's top down evaluation of control devices does not require the analysis of lesser efficiency control devices.

6.3.5. Hazardous Air Pollutants (HAPs)

There are no HAPs that exceed the reporting thresholds found in N.J.A.C. 7:27-17.9(b). Calculations have been included with the revised application to support this assertion. However, a Thermal Oxidizer with a 1 second retention time would be considered the top-rated control device for efficient destruction of HAPs. As such, the Thermal Oxidizer with a greater than 99% destruction efficiency is the top-rated control technology for HAPs including the destruction of dioxins, the Department's top down evaluation of control devices for SOTA does not require the analysis of lesser efficiency control devices.

6.4. Siloxanes

Siloxanes are not expected to be an issue. The biosolids feedstock is expected to have quantities of siloxanes that are below detectable thresholds as most of the siloxanes present would be removed in the biosolids treatment and stabilization process prior to delivery to the Newark Plant. The trace amounts present in the biosolids will not cause any issues in the gasifier since the reducing conditions in the gasifier and the lack of free oxygen are extremely unfavorable to cause siloxanes to oxidize. For these same reasons the silica sand used to make up the bed will not form any siloxanes.

If the unlikely situation arises that siloxanes are present in the producer gas they may oxidize during combustion in the Thermal Oxidizer. However, any deposits will be small and are able to be easily cleaned. Silica is generally more of an issue for reciprocating engines and turbines where deposits are not easily cleaned and can cause irreparable damage. The thermal oxidizer has no such delicate parts and cleaning will be part of scheduled maintenance. The MaxWest gasification facility experienced no emissions issues or ill-effects caused by siloxanes.

7. Emissions Calculations

7.1. Biosolids Bins Emissions Calculations

The US EPA[1] provides the method for calculating emissions from wastewater treatment biosolids as E = EF x Q x C where:

E is the mass emission rate for the volatile organic compound species in grams/day
EF is the emissions factor of the species in grams/ m^3
Q is the volumetric flow rate in m^3 per day
C is equal to 1 – f where f is the emissions control efficiency.

The values provided for the emissions factor are:

$EF_{ammonia} = 2.2\ g/m^3$ Reference 2
$EF_{VOCs} = 1.07\ g/m^3$ Reference 3.

7.1.1. Ammonia Calculation

$E_{ammonia} = EF_{ammonia} \times Q_{ammonia} \times C_{(f=0)} \times \%\ Max\ Time_{/day\ (f=0)} \times 365\ days/year$

7.1.2. VOCs Calculation

E_{VOCs} = EF_{VOCs} x Q_{VOCs} x $C_{(f=0)}$ x % Max $Time_{/day\ (f=0)}$ x 365 days/year

7.1.3. References

1. U.S. EPA, "Preferred and alternative methods for estimating air emissions from wastewater collection and treatment", prepared for Emission Inventory Improvement Program of the U.S. Environmental Protection Agency (U.S. EPA), by Eastern Research Group, North Carolina, March 1997, obtained from the U.S. EPA Web site at http://www.epa.gov/ttn/chief/eiip/techreport/volume02/ii05.pdf.

2. Battye, R.; W. Battye; C. Overcash; and S. Fudge (EC/R Inc., Durham, North Carolina, USA), "Development and selection of ammonia emission factors", prepared for U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C., August 1994.

3. USEPA. September 1991. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources, fifth edition, AP-42. Section 4.3 Wastewater Collection, Treatment and Storage. United States Environmental Protection Agency, Office of Air Quality Planning and Standards. Research Triangle Park, NC, USA.

7.2. Bin Charging Emissions Calculations

When charging the biochar and biosolids unloading bin, about 25% of the biochar and 5% of the biosolids are fines less than 10 microns in size. When loading into the bin, 99% of the fines remain entrained in the pile in the bin and only about 1% becomes uncontrolled dust.

Annual PM10 emission = Total dust/day x OS operating days/year x 25% fines x 1% uncontrolled

7.3. Truck Unloading Emissions Calculations

The unloading station for the biochar and biosolids unloading consists of a suction blower (induction fan) that provides suction through a pipe that surrounds the unloading arm from the bin to the truck. This has an overall capture efficiency of 89.1% for PM10.

About 25% of the biochar and 5% of the biosolids are fines less than 10 microns in size. When unloading from the bin into the truck 95% of the fines remain entrained in the pile in the truck and only about 5% becomes uncontrolled dust.

Annual PM10 emission = Total dust/day x OS operating days/year x 25% fines x 5% uncontrolled x (1-89.1% capture efficiency)

7.4. Biosolids Processing Plant and Stack Emissions Calculations

7.4.1. Summary Table of Operating Scenario 1 and 2 (E1 and E2)

OS1	Sludge Unloading to Receiving Hopper 1				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.037	0.06	0.9950	0.00018	0.00029
CO	0.0	0.0	N/A	0.00	0.00
PM10	0.0	0.0	N/A	0.00	0.00
TSP	0.0	0.0	N/A	0.00	0.00
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
NH3	0.076	0.119	-	0.076	0.119
HAPs	See Exhibit G				

OS2	Sludge Unloading to Receiving Hopper 2				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.04	0.06	0.9950	0.00018	0.00029
CO	0.0	0.0	N/A	0.00	0.00
PM10	0.0	0.0	N/A	0.00	0.00
TSP	0.0	0.0	N/A	0.00	0.00
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
NH3	0.076	0.119	-	0.076	0.119
HAPs	See Exhibit G				

7.4.2. Summary Table of Operating Scenario 3 and 4 (E1 and E2)

OS3	Vented Gas from Sludge Storage Bin 1				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.06	0.24	0.9950	0.00028	0.00122
CO	0.0	0.0	N/A	0.00	0.00
PM10	0.0	0.0	N/A	0.00	0.00
TSP	0.0	0.0	N/A	0.00	0.00
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
NH3	0.114	0.502	0.9000	0.011	0.050
HAPs	See Exhibit G				

OS4	Vented Gas from Sludge Storage Bin 2				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.06	0.24	0.9950	0.00028	0.00122
CO	0.0	0.0	N/A	0.00	0.00
PM10	0.0	0.0	N/A	0.00	0.00
TSP	0.0	0.0	N/A	0.00	0.00
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
NH3	0.11	0.502	0.9	0.011	0.050
HAPs	See Exhibit G				

7.4.3. Summary Table of Operating Scenario 5 and 6 (E3 and E4)

OS5	Particulate Emissions from Gasifier Feed Bin 1				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.0	0.0	N/A	0.00	0.000
CO	0.0	0.0	N/A	0.00	0.000
PM10	1.8	7.8	0.99	0.02	0.078
TSP	1.8	7.8	0.99	0.02	0.078
SOx	0.0	0.0	N/A	0.00	0.000
NOx	0.0	0.0	N/A	0.00	0.000
HAPs	See Exhibit G				

OS6	Particulate Emissions from Gasifier Feed Bin 2				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.0	0.0	N/A	0.00	0.00
CO	0.0	0.0	N/A	0.00	0.00
PM10	1.8	7.8	0.99	0.02	0.08
TSP	1.8	7.8	0.99	0.02	0.08
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
HAPs	See Exhibit G				

7.4.4. Summary Table of Operating Scenario 7 and 8 (E5)

OS7	Gasifier Normal Operations				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	428.2	1,766.3	0.995	2.14	8.83
CO	2,993.4	12,347.7	0.999	2.99	12.35
PM10	194.2	801.1	0.99	1.94	8.01
TSP	194.2	801.1	0.99	1.94	8.01
SOx	275.7	1,137.2	0.96	11.03	45.49
NOx	89.8	370.4	0.95	4.49	18.52
HAPs	See Exhibit G				

Notes:

1. VOC, CO, PM10 and TSP numbers come from the Newark Heat and Material Balance.

OS8	Maintenance Operations - Gasifier Down				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.5	2.0	0.995	0.003	0.010
CO	8.2	30.7	0.999	0.008	0.0307
PM10	0.7	2.8	0.99	0.01	0.0277
TSP	0.7	2.8	0.99	0.01	0.0277
SOx	0.06	0.22	0.96	0.002	0.009
NOx	1.1	4.1	0.95	0.06	0.205
HAPs	See Exhibit G				

References:

1 - Emission estimates are calculated from mass flow rates from the HMB for each operating scenario.

2 - Natural Gas Emission estimates based on AP-42, Chapter 1.4, Tables 1.4-1 and 1.4-2 (updated 07/98).

7.4.5. Summary Table of Operating Scenario 9 and 10 (E6)

OS9	Particulate Emissions Charging Biosolids Loadout Bin				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.0	0.0	N/A	0.00	0.00
CO	0.0	0.0	N/A	0.00	0.00
PM10	0.6	2.3	0.99	0.01	0.02
TSP	0.6	2.3	0.99	0.01	0.02
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
HAPs	See Exhibit G				

OS10	Particulate Emissions during Biosolids Loadout				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.0	0.0	N/A	0.00	0.00
CO	0.0	0.0	N/A	0.00	0.00
PM10	2.8	4.0	0.891	0.30	0.441
TSP	2.8	4.0	0.891	0.30	0.441
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
HAPs	See Exhibit G				

7.4.6. Summary Table of Operating Scenario 11 and 12 (E7)

OS11	Particulate Emissions Charging Biochar Loadout Bin				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.0	0.0	N/A	0.00	0.00
CO	0.0	0.0	N/A	0.00	0.00
PM10	5.2	21.5	0.99	0.05	0.21
TSP	5.2	21.5	0.99	0.05	0.21
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
HAPs	See Exhibit G				

OS12	Particulate Emissions during Biochar Loadout				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.0	0.0	N/A	0.00	0.00
CO	0.0	0.0	N/A	0.00	0.00
PM10	26.04	38.02	0.891	2.84	4.14
TSP	26.04	38.02	0.891	2.84	4.14
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
HAPs	See Exhibit G				

EXHIBIT A

GLOSSARY OF TERMS

Term	Definition	Regulatory Reference
ACFM	Actual cubic feet per minute	
Agglomeration	A mass or collection of particles in a bed formed from low melting point constituents causing the particles to stick together.	
Biochar	By-product of gasification process that consists mostly of ash and carbon.	
Biosolids	a term used for several types of treated sewage biosolids that can be used as soil conditioner	
Btu/scf	British thermal units per standard cubic foot	
Catalyst	A substance that increases the rate of a chemical reaction without itself undergoing any permanent chemical change.	
CEMS	Continuous Emission Monitoring System	
Clinker	Bed deposit formed by sintering or melting of bed particles	
CO	Carbon Monoxide	
Condensate Effluent	Moisture produced from biosolids drying process that is then routed to LRSA for industrial treatment.	
Control Device or Apparatus	Any device which prevents or controls the emission of any air contaminant directly or indirectly into the outdoor atmosphere.	N.J.A.C. 7:27-8.1
Cyclone	Equipment used to separate solids from an air stream.	
DBOOM	Design, Build, Own, Operate and Maintain	
Dried Biosolids	By-product of drying biosolids meeting the standards of US EPA, Part 503 for being safe for land application, also the fuel for the gasifier	
DSCFM	Dry standard cubic feet per minute	
DSCM	Dry Standard Cubic Meter	
Effluent	Any liquid discharge or process waste	
Elutriate	To separate lighter and heavier particles in a mixture by suspension in an upward flow of liquid or gas.	
Emissions	Any air contaminant or category of air contaminants discharged directly or indirectly into the outdoor atmosphere.	N.J.A.C. 7:27-8.1
Emissions Control System	A system used to reduce the amount of emissions that are released during the process.	
Emissions Source or Point	Any part of activity of a stationary source that emits or has the potential to emit any regulated air pollutant or any pollutant listed under 42 U.S.C. § 7412(b)..	N.J.A.C 7:27-8.1

Emissions Unit	Any part of activity of a stationary source that emits or has the potential to emit any regulated air pollutant or any pollutant listed under 42 U.S.C. § 7412(b).	N.J.A.C. 7:27-8.1
Emit	Means to cause or release emissions to the atmosphere.	N.J.A.C. 7:27-8.1
Equipment	Any device capable of causing the emission of an air contaminant, and any stack or chimney, conduit, flue, duct, vent or similar device connected or attached to, or serving the equipment.	N.J.A.C. 7:27-8.1
Eutectics	A mixture of substances that melt at a temperature lower than melting point of the separate constituents.	
Exhaust Stack or Chimney	A flue, conduit or opening designed, constructed, or utilized for the purpose of emitting any air contaminant into the outdoor atmosphere.	N.J.A.C. 7:27-8.1
Facility	The combination of all structures, buildings, equipment, control apparatus, storage tanks, source operations, and other operations that are located on a single site or on contiguous or adjacent sites and that are under common control of the same person or persons.	N.J.A.C. 7:27-8.1
Flue Gas	Exhaust gas from a combustion process such as a thermal oxidizer.	
Fluidized Sand Bed	Air is injected into a bed of sand making the characteristics behave similar to that of a fluid.	
Fugitive Emissions	Any air contaminant emissions released directly or indirectly into the outdoor atmosphere which cannot reasonably pass through a stack or chimney.	N.J.A.C 7:27-21.1
Gasifier	Equipment that breaks down dried biosolids into producer gas and biochar.	
Greenhouse Gas Emissions (GHG)	A gas that absorbs and emits radiant energy causing a greenhouse effect. "Any of the following gases: carbon dioxide (CO_2); methane (CH_4); nitrous oxide (N_2O); certain hydrofluorocarbons (HFC-23, HFC-125, HFC-134a, HFC-143a, HFC-152a, HFC-227ea, HFC-236fa, HFC-4310mee); certain perfluorocarbons (CF_4, C_2F_6, C_4F_{10}, C_6F_{14}); and sulfur hexafluoride (SF_6)."	N.J.A.C. 7:27-8.1
Hazardous Air Pollutants (HAPs)	An air contaminant listed in or pursuant to 42 U.S.C. § 7412(b).	N.J.A.C. 7:27-8.1
Heat Recovery	A process of recovering heat from exhaust air.	
Indirect Emissions	A discharge of any air contaminant into the outdoor atmosphere through any opening that is not a stack or chimney directly connected to the equipment.	N.J.A.C. 7:27-8.1
Induction Fan	Provides continuous induced air flow within a duct or piece of equipment.	

Industrial Wastewater	Wastewater byproduct of industrial processes consisting of mostly water but may also have contaminants that can be treated, recycled, reused or released to a treatment plant capable of removing contaminates and may be reused or released to a sanitary sewer.	
Inert Gas	Gas that does not undergo chemical reactions, such as nitrogen.	
Insignificant Source	Any piece of equipment or source operation that does not need a permit and certificate under.	N.J.A.C. 7:27-8.1
LHV	Lower Heating Value	
Newark Biochar Production Facility ("the Plant")	The Plant includes all of the process units and equipment necessary to convert 430 tons/day, 78% moisture domestic wastewater biosolids to dried biosolids, biochar and producer gas.	
Mass Flow	The rate of movement of a substance using units of mass such a pound or kilogram	
MMBtu	Million British Thermal Units	
NESHAP	A National Emission Standard for a Hazardous Air Pollutant as promulgated under 40 CFR Part 61 or 40 CFR Part 63.	NJAC 7:27-8.1
NH3	Ammonia	
NJID	New Jersey Identification numbering system for equipment.	
NOx	Nitrogen Oxide, a greenhouse gas.	
NSPS	Standards of Performance for New Stationary Sources as promulgated under 40 CFR 60, commonly referred to as New Source Performance Standards.	N.J.A.C. 7:27-8.1
Operating Scenario (OS)	Different scenarios of operating a plant that have different characteristics, operating equipment, conditions, flows or other material differences.	
Particles	Any material, except uncombined water, which exists as liquid particles or solid particles at standard conditions.	N.J.A.C. 7:27-8.1
Particle Filter	Emission Control System used to mitigate particles released in facility process.	
Pb2	Lead II	
PM 10	A class of air contaminants that includes all particulate matter having an aerodynamic diameter less than or equal to a nominal 10 microns.	N.J.A.C. 7:27-8.1
PM2.5	A class of air contaminants that includes all particulate matter having an aerodynamic diameter less than or equal to a nominal 2.5 microns.	N.J.A.C. 7:27-8.1
ppmvd	Parts per million by volume dry	

Process Flow Diagram (PFD)	A graphical representation of a process that includes process and equipment information.	
Process Unit	Equipment identified as part of a plant but not considered "Equipment" as defined above and having a NJID. Equipment assembled to produce intermediate or final products. A process unit can operate independently if supplied with sufficient feed or raw materials and sufficient storage facilities for the product. The storage and transfer of product or raw materials to and from the process unit shall be considered separate from the process unit for the purposes of making reconstruction determinations. Product recovery equipment shall be considered to be part of the process unit, not part of the control apparatus.	N.J.A.C. 7:27-8.1
Producer Gas	Gas created from the gasification process that can be combusted to create heat for the biosolids drying process.	
Psig	Pound-force per square inch gauge	
PTE	Potential to Emit	
Pug Mill	A machine for mixing biosolids to a homogeneous state before being conveyed to the biosolids dryer.	
Purge (Nitrogen)	Removing oxygen from an enclosure with nitrogen to prevent a build-up of gases.	
RADIUS	Electronic preparation of New Jersey Air Permit.	
Refractory Lining	A protective layer inside a piece of equipment that acts as a protective barrier to withstand high operating temperatures.	
scfm	Standard cubic foot per minute	
SCR	Selective Catalytic Reduction, a method for mitigating NOx generated from biosolids processing.	
Significant Source Operation or Significant Source or Significant Equipment	A source that is classified as a significant source pursuant to N.J.A.C. 7:27-8.2(c) and that is not exempted from being a significant source pursuant to N.J.A.C. 7:27-8.2(d) or (e). Any equipment or source operation that may emit one or more air contaminants, except carbon dioxide (CO2), directly or indirectly into the outdoor air and belongs to one of the categories listed in N.J.A.C. 7:27-8.2(c), is a significant source	N.J.A.C. 7:27-8.1
Biosolids (Domestic Wastewater)	Semi-solid material from domestic wastewater	

Sorbent	A substance that has properties to collect molecules from another substance.	
State of the Art (SOTA)	Construction, installation, reconstruction, or modification of equipment and control apparatus that is a significant source meeting the criteria set forth in N.J.A.C. 7:27-8.12.	N.J.A.C. 7:27-8.1
Storage Tank	Any tank, reservoir, or vessel which is a container for liquids or gases, wherein: 1. No manufacturing process, or part thereof, other than filling or emptying takes place; and 2. The only treatment carried out is that necessary to prevent change from occurring in the physical condition or the chemical properties of the liquids or gases deposited into the container. Such treatment may include recirculating, agitating, maintaining the temperature of the stored liquids or gases, or replacing air in the vapor space above the stored liquids or gases with an inert gas in order to inhibit the occurrence of chemical reaction.	N.J.A.C. 7:27-8.1
Source Operation or Source	Any process, or any identifiable part thereof, that emits or can reasonably be anticipated to emit any air contaminant either directly or indirectly into the outdoor atmosphere. A source operation may include one or more pieces of equipment or control apparatus.	N.J.A.C. 7:27-8.1
SOx	Sulfur Oxide, a toxic gas.	
Steady State	Stable plant operation that does not vary significantly	
Step Down Transformer	An electrical transformer that decreases voltage from primary to secondary.	
Sump	A pit or hallow in which liquid collects.	
Thermal Oxidizer	A refractory lined steel cylinder with ports for the admission of air to promote the homogeneous blending of the producer gas with air taking the resultant mass to combustion.	
Total Suspended Particulate (TSP)	Any air contaminant dispersed in the outdoor atmosphere which exists as solid particles or liquid particles at standard conditions and is measured in accordance with N.J.A.C. 7:27B-1; 40 CFR 60, Appendix A, Methods 5 through 5H; or another method approved by the Department and EPA.	N.J.A.C. 7:27-8.1
VOC	Volatile Organic Compound	

EXHIBIT B

MAXWEST SANFORD, FL

STACK EMISSIONS TEST REPORT

EMISSIONS SOURCE TEST REPORT
OF
MaxWest-Sanford, LLC Biosolids Gasification and Energy Recovery System

Revised August 10, 2011

Prepared for

MaxWest Environmental Systems, Inc
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Prepared by:

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GROVE
SCIENTIFIC & ENGINEERING

Report Certification

This test was conducted under our direction. The reported parametric and stack test data comply with 40 CFR Part 60 Subpart MMMM and the test protocol submitted to the Florida Department of Environmental Protection and are true and correct to the best of our knowledge. All test procedures were conducted per the reported methods and followed without modification.

Sara Greivell, Project Manager | Date

Bruno A. Ferraro, CEP, QEP | Date
President

MaxWest Sanford Authorized Representative
Report Certification

This emission test was conducted under my direction. To the best of my knowledge, the production data required and provided to Grove scientific & Engineering Company are true and correct.

Jeff Snyder, Vice President Operations Date

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ATTACHMENTS

SECTION 1
INTRODUCTION

1.1 BACKGROUND

MaxWest - Sanford, LLC is located at the City of Sanford South Wastewater Reclamation Facility at 3540 Cameron Avenue, Sanford, Florida and operates under the Florida Department of Environmental Protection (FDEP) air construction permit 1170409-001-AC. This Permit was issued on October 18, 2010 and expires October 30, 2011. This permit allowed the construction of a biosolids (sewage sludge) gasification and energy recovery systems, an indirect-fired, continuous biosolids dryer and the associated air pollution control systems.

Specific condition 12 of this permit requires MaxWest to test the gasification system "within 90 days of reaching the maximum production rate but no later than 180 days after initial startup...". MaxWest determined that this date was May 27, 2011. This emission test was conducted on May 3, 2011 by Analytical Testing Consultants, Inc. (ATC) under the direction of Grove Scientific & Engineering Company (GSE). MaxWest and GSE collected parametric data, biosolids and ash samples.

On December 7, 2010, the US EPA signed a ruling that the MaxWest gasification system is classified as a "sewage sludge incinerator" (SSI). Though MaxWest disagrees with this ruling, they have made the decision not to challenge it at this time. This ruling established that 40 CFR Part 61

Subpart E - “National Emission Standard for Mercury” Applies to this source.

On March 21, 2011 the US EPA Administrator signed into law New Source Performance Standards (NSPS) that affect SSI. The rule that will affect MaxWest-Sanford, LLC is 40 CFR Part 60 Standards of Performance for New Stationary Sources and Emission Guidelines for Sewage Sludge Incinerators; Subpart MMMM “Emission Guidelines and Compliance Times for Existing Sewage Sludge Incineration Units”. A recent ruling by the Federal courts have challenged EPA on how the SSI rules were promulgated. This may delay or change these new subparts. For the purposes of this report, we reference the subpart as it is currently published.

1.2 Gasification System Description

The MaxWest gasification system is a proprietary design. The following is a general description of the system and how it works;

Dried biosolids are used as a fuel for the gasifier. Syngas or producer gas is generated from the starved-air thermal chemical reaction in the primary gasifier. This producer gas is directly fired in an oxygen-rich thermal oxidizer and generates heat. This heat is absorbed in a heat exchanger by a thermal fluid. This hot thermal fluid is used to heat the continuous drier where wet biosolids are dried.

The cooled flue gas is first treated by a dry-lime injected fabric filter, then by a raw water, non-pH adjusted, single-pass scrubber before exiting the main exhaust stack. The existing MaxWest system was designed prior to the new regulations were promulgated.

1.3 Test Protocol

A test protocol was submitted to FDEP on April 1, 2011 following a meeting at FDEP on March 24, 2011. The following test parameters and methods were conducted on the outlet of the gasification system.

- 1-5 (flow, moisture, gases and PM),
- 6C (SO_2 by instrument),
- 7E (NOx by instrument),
- 9 (visible emissions (VE) for the stack outlet),
- 10 (CO by instrument),
- 22 (VE from ash conveying system),
- 23 (Dioxin/Furan),
- 25A (VOC by instrument),
- 26A (PM with HCI and HF)
- 29 (multi-metals arsenic, beryllium, cadmium, chromium, lead, mercury and nickel)
- Minimum sample volumes per Subpart MMMM Table 3 will be collected for these test methods.
- Collect a sample of the dry fuel for Hg by EPA Method 105.

Subpart MMMM Table 4 outlines the requirements for operating parameters that must be established during a stack test. MaxWest will establish the following parameters;

1. Afterburner combustion chamber temperature 12-hour block average temperature, recorded continuously.
2. Scrubber - MaxWest has a secondary heat exchanger that uses reclaimed water. It is not pH adjusted and does not re-circulate. There is a magnehelic to read but does not record the pressure drop and we will record this on a form. Measure the minimum water flow rate and establish a 12-hr block average.
3. Fabric filter - This baghouse is not equipped with a bag leak detection system at this time. Monitor inlet and outlet temperature.
4. Lime feed rate - We will establish the lime feed rate to the fabric filter house during the test.
5. Fuel (biosolids) feed rate

These parameters satisfy the FDEP permit requirements, 40 CFR part 61 subpart E and 40 CFR Part 60 Subpart MMMM.

In addition to the above emissions testing, engineering tests were conducted as follows:

- An integrated grab canister sample taken of the syngas for the following list of parameters; CO, CO_2, CH_4, H_2, H_2O, VOC, H_2S, HCl, N_2 and BTU.

- Test the sludge drier exhaust for a list of organic compounds for information purposes only. This list includes amine compounds by GC-NPD, volatile sulfur compounds by GC-SCD, and a library scan by GC-MS

Upstream of the baghouse test for:

- 6C (SO_2 by instrument)
- 26A (PM with HCl and HF) and
- 29 (multi-metals arsenic, beryllium, cadmium, chromium, lead, mercury and nickel).
- volumetric flow and moisture

Collect composite samples of biosolids and ash for each of 3 test runs and analyze for;

- chlorine content
- mercury, lead and cadmium
- C, H, N, O, S, %ash, Btu, proximate fuel analysis

SECTION 2
ANALYSIS OF BIOSOLIDS AND ASH

2.1 Sample Collection

Samples were collected by GSE and MaxWest personnel during the test. Samples were collected at half-hour intervals during each test run then composited volumetrically in GSE's laboratory to make a total of 3 biosolids and 3 ash samples.

To account for the residence time in the gasifier, biosolids samples started hours before the test while ash samples were collected after the start of the test. In accordance with US EPA Method 105 "Determination of Mercury In Wastewater Treatment Plant Sewage Sludges", samples were collected at half-hour intervals from 0630 - 2200 hours for further compositing. Sub-samples were taken volumetrically from each of the half-hour samples corresponding to a stack test sample run and blended to form three (3) well-mixed composite samples.

2.2 Results

In addition to mercury a comprehensive list of parameters were analyzed for the purpose of calculating mass balance and for future system design considerations. All of the biosolids results are presented in Table 2-1. The laboratory report and sample chain-of-custody are included in Attachment A.

Field notes are included in Attachment B.

Ash samples were sampled and composited in a similar manner following Method 105. The results are included in Table 2-2.

Table 2-1: Biosolids Analytical Results

Parameter	Method (ASTM)	Sample 1B Dup (as received)	Sample 1 B (dry)	Sample 2B (as received)	Sample 2B (dry)	Sample 3B (as received)	Sample 3B (dry)
Moisture %	D4442 method A	9.08	n/a	16.99	n/a	18.74	N/a
Ash %	D1102	20.36	22.40	19.09	23.00	19.74	24.29
Volatile Matter %	D3175	60.31	66.33	55.03	66.30	52.75	64.91
Fixed Carbon %	D3172	10.25	11.27	8.89	10.70	8.77	10.80
Sulfur %	D4239 method B	0.92	1.01	0.99	1.19	0.93	1.15
Btu/lb Dry Ash Free	E711	n/a	9942	n/a	10,133	n/a	10,152
Btu/lb	E711	7,015	7,715	6,477	7,803	6,245	7,686
Carbon %	D5291	38.96	42.85	33.95	40.90	32.67	40.20
Hydrogen %	D5291	4.25	4.67	4.23	5.10	4.19	5.15
Nitrogen %	D5291	6.20	6.82	5.77	6.96	5.61	6.90

Parameter	Method (ASTM)	Sample 1B Dup (as received)	Sample 1 B (dry)	Sample 2B (as received)	Sample 2B (dry)	Sample 3B (as received)	Sample 3B (dry)
Oxygen %	D5291	20.23	22.25	18.98	22.85	18.12	22.31
Chlorine %	E776	0.21	0.23	0.21	0.25	0.16	0.20
Mercury ug/g	D6722	0.67	0.74	0.66	0.80	0.53	0.65
Cadmium ug/g	D3683 (mod)	n/a	2.8	n/a	0.5	n/a	<0.6
Lead ug/g	D3683 (mod)	n/a	70	n/a	16	n/a	16

Sample 1B duplicate sample was analyzed

Sample 1B = biosolids composite and blended 6:30 am - 11:00 am

Sample 2B = biosolids composite and blended 11:30 am - 5:00 pm

Sample 3B = biosolids composite and blended 5:30 pm - 10:00 pm

Table 2-2: Ash Analytical Results

Parameter	Method (ASTM)	Sample 4A (as received)	Sample 4A (dry)	Sample 5A (as received)	Sample 5A (dry)	Sample 6A (as received)	Sample 6A (dry)
Moisture %	D4442 method A	50.11	n/a	55.26	n/a	57.10	n/a
Ash %	D1102	14.76	29.58	11.31	25.28	10.83	25.24
Volatile Matter %	D3175	27.73	55.59	28.5	63.70	27.71	64.58

Parameter	Method (ASTM)	Sample 4A (as received)	Sample 4A (dry)	Sample 5A (as received)	Sample 5A (dry)	Sample 6A (as received)	Sample 6A (dry)
Fixed Carbon %	D3172	7.40	14.83	4.93	11.02	4.36	10.18
Sulfur %	D4239 method B	0.54	1.08	0.54	1.20	0.48	1.13
Btu/lb Dry Ash Free	E711	n/a	10577	n/a	10,281	n/a	10,355
Btu/lb	E711	3,716	7,448	3,437	7,682	3321	7742
Carbon %	D5291	19.88	39.86	17.93	40.09	17.22	40.14
Hydrogen %	D5291	2.15	4.30	2.19	4.90	2.10	4.90
Nitrogen %	D5291	3.41	6.83	3.17	7.09	3.04	7.09
Oxygen %	D5291	9.15	18.35	9.60	21.44	9.23	21.50
Chlorine %	E776	0.15	0.30	0.16	0.35	0.12	0.28
Mercury ug/g	D6722	0.39	0.78	0.54	1.20	0.36	0.84
Cadmium ug/g	D3683 (mod)	n/a	0.7	n/a	0.7	n/a	<0.6
Lead ug/g	D3683 (mod)	n/a	21	n/a	18	n/a	18

Sample 4A = Ash composite and blended 10:04 am - 2:30 pm

Sample 5A = Ash composite and blended 3:30 pm - 7:30 pm

Sample 6A = Ash composite and blended 8:03 pm - 11:20 pm

2.3 Daily Mercury Emissions Per Method Modified 105

A laboratory that is certified and utilizes EPA Method 105 could not be located. Since we also ran EPA Method 29 on the flue gas, we selected an alternate analytical method used for coals and other solid fuels. Mercury emissions can be estimated using the sludge analysis from ASTM Method D6722 and the equation in subpart E §61.54(d);

$E_{Hg} = (M\ Q\ F_{sm(avg)}) / 1000$

Q = 14,302 kg/24-hr

Run 1 E_{Hg} = (0.74 ug/g)(14,302 kg/day avg)(0.0908)/1000
Run 1 E_{Hg} = 0.96 g/day or 0.00096 kg/day

Run 2 E_{Hg} = (0.80 ug/g)(14,302 kg/day)(0.1699) / 1000
Run 2 E_{Hg} = 1.94 g/day or 0.0019 kg/day

Run 3 E_{Hg} = (0.65 ug/g)(14,302 kg/day)(0.1874) / 1000
Run 3 E_{Hg} = 1.74 g/day or 0.0017 kg/day

The allowable mercury emission rate per 40 CFR Part 61 Subpart E is 3.2 kg of mercury per 24-hour period. The 3-run average was 0.00152 kg/24hr.

2.4 Daily Mercury Emissions Based on Method 29

The mercury (Hg) emissions were measured by US EPA Method 29 and are presented in Section 6 of this report. The 3-run average was measured at 5.44E-05 lbs/hr corrected to 7% oxygen. The daily emission rate of Hg can be calculated from these results as follows:

(0.0000544 lbs/hr)(24 hrs/day) = 0.0013 lbs Hg/day @14,302 kg of biosolids

0.0013 lbs/day = 0.00059 kg/24-hr
Allowable = 3.2 kg/24-hr

These emissions data are more representative than the sludge analysis data since the M29 data are after the two air pollution control devices. This emission rate demonstrates compliance with the emission limiting standard of Subpart E.

SECTION 3
PARAMETRIC DATA

3.1 Parametric Data Requirements

Subpart MMMM Table 4 outlines the requirements for operating parameters that must be established during a stack test. MaxWest established the following parameters;

1. Afterburner combustion chamber temperature 12-hour block average temperature, recorded continuously.
2. Scrubber - MaxWest has a secondary heat exchanger that uses reclaimed water. It is not pH adjusted and does not re-circulate. There is a magnehelic to read but does not record the pressure drop and we recorded this on a form. Measure the minimum water flow rate and establish a 12-hr block average.
3. Fabric filter - This baghouse is not equipped with a bag leak detection system at this time. Monitor inlet and outlet temperatures.
4. Lime feed rate - We established the lime feed rate to the fabric filter house during the test.
5. Fuel (biosolids) feed rate

3.2 Afterburner Combustion Chamber Temperature

Oxidizer temperature is recorded continuously by a computerized data management program. This program presents the data in graphical form. From the program we imported the data into and Excel spreadsheet to calculate the 12-hour block average temperature as required by subpart MMMM. These data are included in Attachment C.

During this test the afterburner combustion chamber temperature remained above 1500 Deg F. The 12-hour block average temperature was 1760 Deg F.

3.3 Scrubber Water Flow and Pressure Drop

The secondary heat exchanger also acts as a scrubber for the gasifier flue gas. There is a manual magnehelic pressure gauge on the scrubber that measures in inches of water gauge. The scrubber is also equipped with a water flow meter and a water flow gauge. Both of these are manual and must be read together and the data added together to obtain the actual water flow. These data were recorded on field data sheets and are included in Attachment D and presented below.

Table 4 of subpart MMMM requires:

- Minimum pressure drop
- Minimum flow rate
- Minimum pH

The following pressure drop and flowrate data were obtained from our field data sheet. The raw scrubber water is single-pass reclaimed water and not pH adjusted. These data were obtained by MaxWest from the treatment plant's daily records.

The minimum flow rate was calculated as follows;

Time period 11:30 am to 2:30 pm = 180 minutes

Initial reading from water meter @ 11:30 = 01697220.0 gallons

Final reading from water meter @ 2:30 = 01707586.0 gallons

(01707586.0) -(01697220.0) = 10,366 gallon in 180 minutes

(10,366 gal)/(180 min) = 57.6 gal/min + 9 gpm from second meter

Minimum Flow Recorded = 66.58 gal/min

Table 3-1: Parametric Data for Scrubber

Parameter	Minimum Recorded Reading
Pressure Drop	0.8 inches of Water Gauge
Flow Rate	66.58 gal/min
pH	8.03*

* Note: pH obtained from wastewater treatment plant daily records

3.4 Lime-Injected Fabric Filter

Subpart MMMM requires a bag-leak detector on all fabric filters (baghouse). This baghouse is not equipped with a bag-leak detector. One will be installed by the compliance deadline. We did collect data that are very important to pollutant control system performance. These data are summarized below in Table 3-2 and included in Attachment E.

Table 3-2: Parametric Data for Fabric Filter

Parameter	Reading
Lime Injection Rate	3.31 lbs/hr avg
Inlet Baghouse Temp Run 1	290 deg F (4-hr block average)
Inlet Baghouse Temp Run 2	350 deg F (4-hr block average)
Inlet Baghouse Temp Run 3	386 deg F (4-hr block average)
Outlet Baghouse Temp Run 1	238 deg F (4-hr block average)
Outlet Baghouse Temp Run2	268 deg F (4-hr block average)
Outlet Baghouse Temp Run 3	284 deg F (4-hr block average)

3.5 Fuel (biosolids) Feed Rate

The biosolids feed rate was recorded by the computer data management system. The data are included in Attachment F and summarized in Table 3-3. The permitted fuel feed rate is 6307 tons of dry biosolids per consecutive 12 months. In the air permit application we stated the maximum feed rate was 1440 lbs/hr of dry biosolids.

Table 3-3: Biosolids feed Rate

Run Number	Average Pounds/hour Feed Rate
1	1513
2	1241
3	1259
3-run Average	1338

The 3-run average of 1338 lbs/hr of dry biosolids plus 10% will limit the gasifier to 1471.8 lbs/hr of biosolids input.

SECTION 4
PRODUCER GAS AND DRIER EXHAUST ANALYTICAL RESULTS

4.1 Purpose

SUMMA canister samples were collected between the gasifier and the thermal oxidizer for analysis of the producer gas. These data will be evaluated for future gasifier design. An additional set of gas samples were collected from the sludge drier exhaust for information purposes only. The laboratory report of these samples is included in Attachment G.

4.2 Producer Gas

The results of the producer gas analysis are presented in table 4-1.

Table 4-1: Results of Producer Gas Analysis

Parameter & units	Sample 1 (can 1635)	Sample 2 (can 1631)
Btu/SCF	56.6	74.5
Molecular Weight	28.4	28.6
Ethane (ppm)	794	1,324
C2 as Ethane (ppm)	2,144	5,122
Propane (ppm)	315	484
C3 as Propane (ppm)	859	1,673

Parameter & units	Sample 1 (can 1635)	Sample 2 (can 1631)
Butane (ppm)	76.6	112.7
C4 as Butane (ppm)	595	1,015
Pentane (ppm)	19.8	0.789 ND
C5 as Pentane (ppm)	613	1,038
Hexane (ppm)	15.2	20.9
C6 as Hexane (ppm)	1,504	2,354
TVOC	10,829	19,408
Hydrogen (%)	5.46	7.94
Moisture (%)	15	15
Oxygen (%)	5.17	7.05
Nitrogen (%)	54.7	86.3
Carbon Monoxide (%)	4.47	7.54
Methane (%)	0.847	1.5
Carbon Dioxide (%)	9.23	15.1
Hydrogen Sulfide (ppm)	0.41 ND	0.517 ND
Total Reduced Sulfur as H2S (ppm)	297 E	354 E
Hydrogen Chloride (ppm)	35.70	34.24

ND= not detected at this level (could be detected at a lower concentration)

E = indicates an analytical result exceeding 100% of the highest calibration point. The associated value should be considered as an estimate.

4.3 Drier Exhaust

The drier exhaust was sampled using a SUMMA Canister for a list of analytes that will be used for information purposes only. Only those analytes that were identified were reported. The results are summarized in Table 4-2.

Table 4-2: Analysis of Drier Exhaust

Parameter & Units	Drier Exhaust Sample
Ethanol amine (ppm)	0.68 ND
Ethyl amine (ppm)	0.42 ND
Trimethyl amine (ppm)	28.07
Triethanol amine (ppm)	0.18 ND
Ammonia (ppm)	158.75
Sulfate (ppm)	19.36 E

ND= not detected at this level (could be detected at a lower concentration)
E = indicates an analytical result exceeding 100% of the highest calibration point. The associated value should be considered as an estimate.

SECTION 5
EMISSIONS SUMMARY

5.1 Methods

All sampling and analysis followed the methods submitted in the test protocol without modification. Sample volumes as required by Subpart MMMM were also followed. Emissions results were corrected to 7% oxygen as required by Subpart MMM. The test results provided by Analytical Testing Consultants, Inc. are included in its entirety in Attachment H.

5.2 Summary of Emissions

Stack parameters are presented in Table5-1. Emissions are summarized in Table 5-2 along with the comparable allowable limits in Subpart MMMM for existing multi-hearth SSI.

Table 5-1: Stack Parameters

Parameter	Run 1	Run 2	Run 3	Average
Flow (ACFM)	1875	1944	1920	1913
Flow (SCFMD)	1753	1808	1786	1781
Stack Temp (^{o}F)	85.33	86.08	86.38	85.93
Moisture (%)	3.58	3.91	3.74	3.74
CO2 (%)	5.17	5.17	5.17	5.17
O2 (%)	15.18	15.18	15.18	15.18
CO (%)	0	0	0	0
N2 (%)	79.65	79.65	79.65	79.65

Table 5-2: Emission Summary Corrected to 7% Oxygen

Parameter	Run 1	Run 2	Run 3	Average	Allowable
PM (gr/dscf)	0.005	0.011	0.013	0.0096	
PM (Lbs/hr)	0.073	0.172	0.194	0.15	
PM (mg/DSCM)	11.10	25.30	29.00	21.80	80
HCl (PPM)	1.83	1.89	1.79	1.83	1.2
HCl (lbs/hr)	0.018	0.019	0.018	0.02	
HF (PPM)	6.670	6.942	4.977	6.196	
HF (lbs/hr)	0.032	0.035	0.031	0.03	
NOx (PPM)	429.8	398.6	468.1	432.17	220
NOx (lbs/hr)	5.3	4.9	5.8	5.8	
CO (PPM)	16.6	4.4	2.6	7.87	3800
CO (lbs/hr)	0.1	0.0	0.0	0.03	
VOC (PPM)	4.9	7.3	19.4	10.5	
VOC (lbs/hr)	0.0	0.1	0.2	0.1	
SO_2 (PPM)	0	11.3	1.2	4.17	26
SO_2 (lbs/hr)	0.0	0.1	0.0	0.03	
Arsenic (lbs/hr)	8.34E-06	8.49E-06	1.14E-5	9.41E-06	
Arsenic (mg/DSCM)	1.23E-03	1.24E-03	1.68E-03	1.38E-03	
Beryllium (lbs/hr)	7.70E-07	7.84E-07	7.62E-07	7.72E-07	
Beryllium (mg/DSCM)	1.13E-04	1.14E-04	1.12E-04	1.13E-04	
Cadmium (lbs/hr)	7.70E-07	3.92E-07	3.17E-07	4.93E-07	
Cadmium (mg/DSCM)	1.13E-04	5.70E-05	4.68E-05	7.23E-05	0.095
Chromium (lbs/hr)	1.63E-04	9.67E-05	2.86E-05	9.61E-05	
Chromium (mg/DSCM)	2.40E-02	1.41E-02	4.21E-03	1.41E-02	
Lead (lbs/hr)	9.62E-06	3.92E-06	3.17E-06	5.57E-06	
Lead (mg/DSCM)	1.42E-03	5.70E-04	4.68E-04	8.19E-04	0.30
Mercury (lbs/hr)	4.94E-05	5.29E-05	6.09E-05	5.44E-05	
Mercury (mg/DSCM)	7.27E-03	7.70E-03	8.98E-03	7.98E-03	0.28
Nickel (lbs/hr)	9.82E-05	5.81E-05	2.35E-05	5.99E-05	

Parameter	Run 1	Run 2	Run 3	Average	Allowable
Nickel (mg/DSCM)	1.44E-02	8.46E-03	3.46E-03	8.77E-03	
D/F Total (ng/DSCM)	3.92	4.56	7.15	5.21	5.0
D/F TEQ (ng/DSCM)	0.0144	0.0105	0.0605	0.0285	0.32
D/F TEQ (lbs/hr)	9.33E-11	6.78E-11	3.92E-10	1.84E-10	

5.3 Discussion

The test data are very favorable. Particulate matter and the associated metals are well controlled by the lime-injected baghouse. You will note from the data that NOx averaged 432 ppm @ 7% oxygen which is above the allowable in Table 3 of Subpart MMMM. The MaxWest system is not equipped with NOx control technology. Future engineering improvements will include NOx control.

Mercury emissions meet both the limits in Subpart E (0.00059 kg/24-hr verses the allowable rate of 3.2 kg/24-hr) and the Subpart MMMM Table 3 rate (0.00798 mg/DSCM verses the allowable of 0.28 mg/DSCM).

The two acid gases, HCl and HF, show HCl concentrations slightly above the Subpart MMMM limits. There is no limit for HF. However, due to the low flowrate, the actual pounds of acid gas emissions are very low. HCl measured 0.02 lbs/hr and HF measured 0.03 lbs/hr. The additional acid gases can be controlled by converting the existing raw water scrubber to a caustic scrubber or possibly by increasing the lime injection rate to the baghouse. Future engineering improvements will address additional acid gas control.

Lastly, the source is well in compliance with the dioxin/furan (D/F) TEQ emission rate allowed by Subpart MMMM (0.0285 ng/DSCM verses 0.32 ng/DSCM allowed). The D/F on a total mass basis just exceeded the allowable (5.21 ng/DSCM verses 5.0 ng/DSCM allowed). However, Subpart MMMM allows either the total mass or the TEQ emission rates to be report. So, the source is well in compliance with the D/F TEQ emission rate.

5.4 Visible and Fugitive Emissions

A Method 9 visible emissions (VE) test was conducted on the stack outlet. The VE data sheets are included in Attachment I. No visible emissions were observed (0% opacity). Subpart MMMM has no stack VE standard. The permit allows a maximum of 20% opacity.

Fugitive emissions from the ash handling system must be tested for three (3) 1-hour periods by US EPA Method 22. Subpart MMMM allows for no more that 5% fugitive emissions of the hourly observation period. The 3, 1-hour observation periods showed no fugitive emissions from the ash handling system. These results are also included in Attachment I.

SECTION 6

UNCONTROLLED EMISSIONS (BEFORE THE BAGHOUSE AND SCRUBBER)

6.1 Uncontrolled Emission Results

Samples were collected at the exit of the heat exchanger and prior to the air pollution control device for information and engineering design purposes only. The data are presented in their entirety in the ATC report and summarized below in Table 6-1.

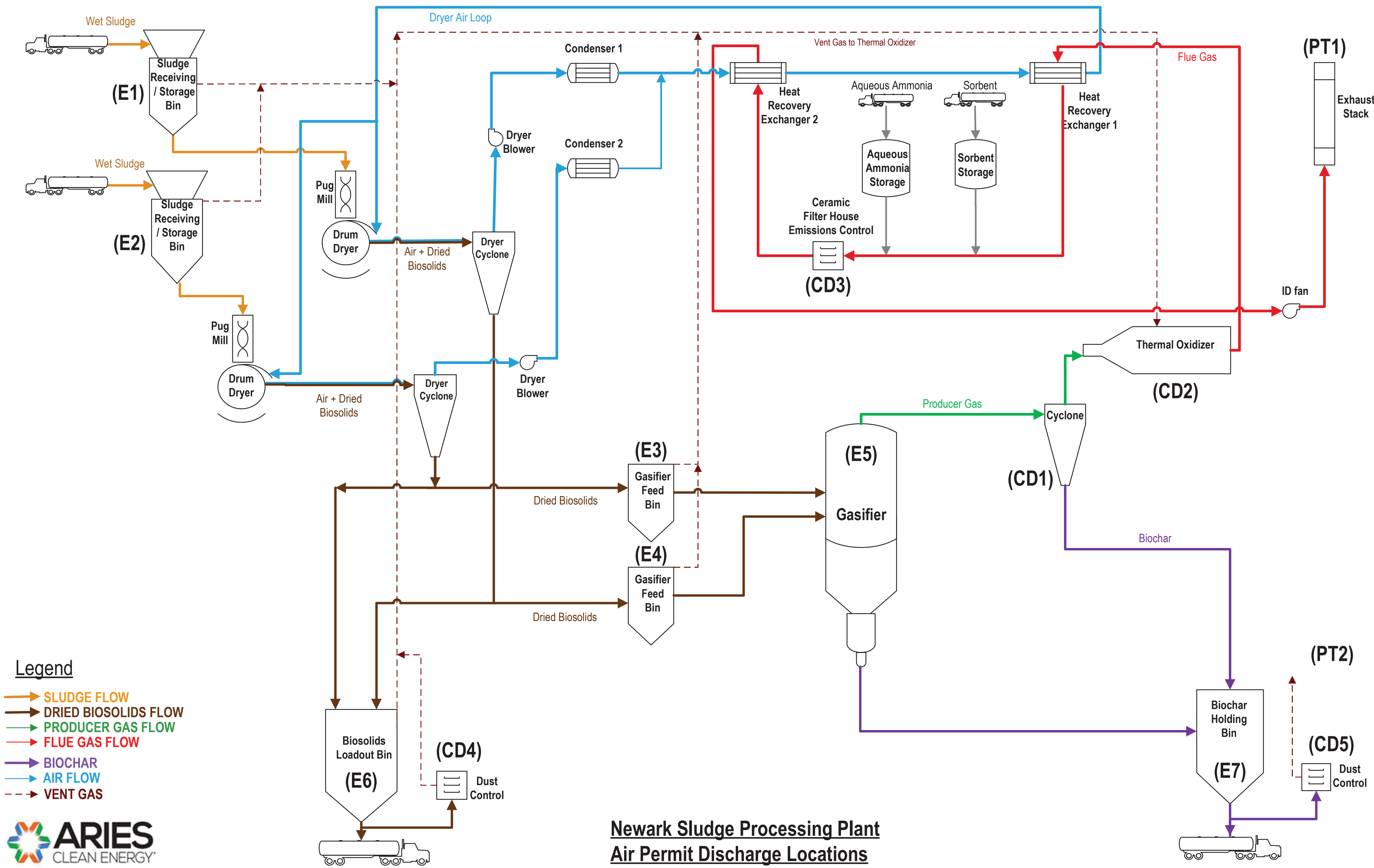
Table 6-1: Summary of Uncontrolled Emissions

Parameter	Run 1	Run 2	Run 3	Average
Flow (ACFM)	2706	3136	3125	2989
Flow (SCFMD)	14204	1587	1565	1525
Stack Temp (^{o}F)	425	438	443	435
Moisture (%)	11.78	13.87	14.28	13.31
CO2 (%)	7.81	7.81	7.81	7.81
O2 (%)	10.0	10.0	10.0	10.0
CO (%)	0	0	0	0
N2 (%)	82.19	82.19	82.19	82.19
PM (gr/dscf)	0.01	0.0045	0.01	0.01
PM (lbs/hr)	0.09	0.06	0.14	0.10
HCl (PPM)	41.96	53.61	58.34	51.31
HCl (lbs/hr)	0.34	0.48	0.52	0.45
HF (PPM)	4.65	6.47	9.10	6.74
HF (lbs/hr)	0.02	0.03	0.04	0.03

Parameter	Run 1	Run 2	Run 3	Average
Arsenic (lbs/hr)	9.47E-06	1.30E-05	1.32E-05	1.19E-05
Beryllium (lbs/hr)	3.36E-07	5.72E-07	7.70E-07	5.59E-07
Cadmium (lbs/hr)	5.49E-05	5.78E-05	5.92E-05	5.73E-05
Chromium (lbs/hr)	6.12E-03	2.40E-02	3.98E-02	2.33E-02
Lead (lbs/hr)	4.40E-04	7.88E-04	5.41E-04	5.90E-04
Mercury (lbs/hr)	1.02E-04	1.42E-04	1.60E-04	1.35E-04
Nickel (lbs/hr)	3.45E-03	1.28E-02	2.04E-02	1.22E-02
SO2 (PPM)	498.92	728.32	444.03	557.09
SO2 (lbs/hr)	7.60	11.10	6.70	8.47

EXHIBIT C

PROCESS FLOW DIAGRAM



Newark Sludge Processing Plant
Air Permit Discharge Locations

EXHIBIT D

EPA LETTER DATED DECEMBER 19th, 2013 re: GASIFICATION

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

DEC 19 2013

OFFICE OF
ENFORCEMENT AND
COMPLIANCE ASSURANCE

Jeff Snyder
Chief Marketing Officer
MaxWest Environmental Systems Incorporated
1485 International Parkway
Suite 1031
Lake Mary, Florida 32746

RE: Request for Determination of Applicability under 40 CFR Part 60, Subpart MMMM - Emissions Guidelines and Compliance Timelines for Existing Sewage Sludge Incineration Units

Dear Mr. Snyder:

This letter is in response to your email of November 7, 2013, in which you inquired on the status of a September 24, 2013, request for applicability submitted on behalf of MaxWest Environmental Systems, Incorporated (MaxWest) by Ms. Bernadette Rappold, of McGuire Woods. Ms. Rappold requested a determination of applicability under 40 CFR Part 60, Subpart MMMM - Emissions Guidelines and Compliance Timelines for Existing Sewage Sludge Incineration Units (SSI EG Rule) for a sewage sludge gasifier located in Sanford, Florida and owned by MaxWest. Your November 7, 2013 email confirms that the McGuire Woods' request for applicability is being made on behalf of MaxWest.

For the reasons stated below, the Environmental Protection Agency (EPA) believes that the neither the MaxWest sewage sludge gasifier nor thermal oxidizer process heater are subject to the SSI EG Rule.

Background

According to the McGuire Woods' request, MaxWest constructed a fixed bed downdraft gasifier for processing biosolids[1] in late 2008. Operation began during September 2009. The original fixed bed downdraft gasifier was replaced with a fluidized bed design; construction on this unit began September 26, 2011[2]. According to information provided in your letter, the current process involves a continuous feed of dried biosolids into the gasifier. The gasifier is operated in an oxygen-starved environment at a temperature of approximately 704 degrees celcius (°C). No flame is applied to the sewage sludge in the gasifier, nor is a flame propogated as a result of the heating. The gasifier produces what is called a synthetic gas or "syngas." Once the syngas exits the gasifier, it is routed through a particulate matter cyclone and then to a process heater and heat exchanger for heat recovery. The

[1] MaxWest provides that the biosolid feed to the gasifier is sewage sludge.
[2] In determining applicability to Subpart MMMM, the EPA used the "commenced construction" dates as provided by MaxWest. In other words, we did not determine if the applicability of Subpart LLLL at Section 60.4775 applies instead.

syngas is combusted in the process heater to generate the heat needed to dry new incoming sludge. The flue gas exiting the process heater and heat exchanger is routed to a baghouse and a wet scrubber.

EPA Response

As means of background, an emissions guideline (such as the SSI EG) does not apply directly to a source. Instead, the emissions guideline applies to Administrators of air quality programs in a state or in a United States protectorate. The emissions guideline directs those Administrators on the content, timing, and requirements for developing a state plan in order to implement the guideline. A state is required to submit a plan for approval to EPA, to implement and enforce the EG, not later than 1 year after EPA promulgates the EG. See U.S.C. §7429(b)(2). If a state has not submitted an approvable plan within two years after the date of promulgation of an EG, then the EPA shall develop, implement and enforce a federal plan. See U.S.C. §7429(b)(3). Emissions guidelines are not enforceable until the EPA approves a state plan (or adopts a federal plan that implements and enforces the guideline), and the state (or federal) plan has become effective. The SSI EG was promulgated on March 21, 2011, and Florida did not submit a state plan for the SSI EG by the March 21, 2012, deadline. See Section 60.5005(b). EPA is currently drafting a proposed federal implementation plan.

For the purposes of this response, we are determining whether MaxWest owns and operates an SSI as that term is defined in the SSI EG Rule, and therefore, whether the SSI Federal Plan would be applicable, once finalized.

According to Section 60.5060, the SSI EG rule applies to SSI units that are constructed on or before October 14, 2010, or modified on or before September 21, 2011.

An SSI unit is defined at Section 60.5250 as:

> . . . an incineration unit combusting sewage sludge for the purpose of reducing the volume of the sewage sludge by removing combustible matter. Sewage sludge incineration unit designs include fluidized bed and multiple hearth. A SSI unit also includes, but is not limited to, the sewage sludge feed system, auxiliary fuel feed system, grate system, flue gas system, waste heat recovery equipment, if any, and bottom ash system. The SSI unit includes all ash handling systems connected to the bottom ash handling system. The combustion unit bottom ash system ends at the truck loading station or similar equipment that transfers the ash to final disposal. The SSI unit does not include air pollution control equipment or the stack.

Sewage sludge is also defined at Section 60.5250 as:

> . . . [a] solid, semi-solid, or liquid residue generated during the treatment of domestic sewage in a treatment works. Sewage sludge includes, but is not limited to, domestic septage; scum or solids removed in primary, secondary, or advanced wastewater treatment processes; and a material derived from sewage sludge. Sewage sludge does not include ash

generated during the firing of sewage sludge in a sewage sludge incineration unit or grit and screenings generated during preliminary treatment of domestic sewage in a treatment works.

The preamble to March 21, 2011, final rule describes an SSI unit as "an enclosed device or devices using controlled flame combustion that burns sewage sludge for the purpose of reducing the volume of sewage sludge by removing combustible matter." See 76 FR 15372. According to the information provided by MaxWest, no flame is applied or propogated in the gasifier and the gasifier prevents combustion by limiting the air-to-sludge ratio such that combustion cannot occur. Therefore, we do not believe that the gasifier is an SSI, because it does not combust sewage sludge.

With regard to the thermal oxidizer process heater, combustion of the syngas does take place in this unit. The definition of sewage sludge at Section 60.3930 includes "material derived from sewage sludge." According to the information provided by Maxwest, the syngas is derived from sewage sludge through the gasification process. The definition of sewage sludge is expressly limited to the "solid, semisolid, or liquid residue generated during the treatment of domestic sludge in a treatment works." Since syngas is a gas, and not a solid, semisolid, or liquid, it does not meet the definition of sewage sludge in the SSI EG rule (even though it is derived from sewage sludge). Therefore, EPA believes that the combustion of the syngas in MaxWest's thermal oxidizer process heater is not subject to the SSI EG Rule.

On December 7, 2010, EPA issued an applicability determination under 40 CFR 61, Subpart E, for MaxWest's Sanford fixed bed downdraft gasifier and thermal oxidizer process heater. See enclosure. See also Control Number Z130001 at: www.epa.gov/compliance/monitoring/programs/caa/adi.html. EPA promulgated the Part 61 emissions standards in 1975 under the authority of Section 112 (hazardous air pollutants) that existed at that time and prior to the enactment of Section 129 in the 1990 Clean Air Act Amendments. The provisions of the Part 61 regulations continue to apply as described in that determination and are unrelated to the SSI EG rule.

This response was coordinated with the Office of General Counsel, EPA Region 4, and the Office of Air Quality Planning and Standards, and is based on the information provided by MaxWest and counsel. If you have any additional questions, please contact Marcia Mia of my staff, at:
(202) 564-7042 or by email at: mia.marcia@epa.gov.

Sincerely,

Edward J Messina

Edward Messina, Director
Monitoring, Assistance, and Media Programs Division
Office of Compliance

Enclosure

cc: Bernadette Rappold, McGuire Woods
Cameron Prell, McGuire Woods
Lisa Sharp, McGuire Woods

EXHIBIT E

EMISSIONS CALCULATIONS

SEPARATELEY ATTACHED SPREADSHEET

E – Newark Emissions Calculation Final.xls

EXHIBIT F

HAPs REVIEW WORKSHEET

SEPARATELEY ATTACHED SPREADSHEET

F – Newark HAPs Calculation.xlsx

EXHIBIT G

RISK REVIEW WORKSHEET

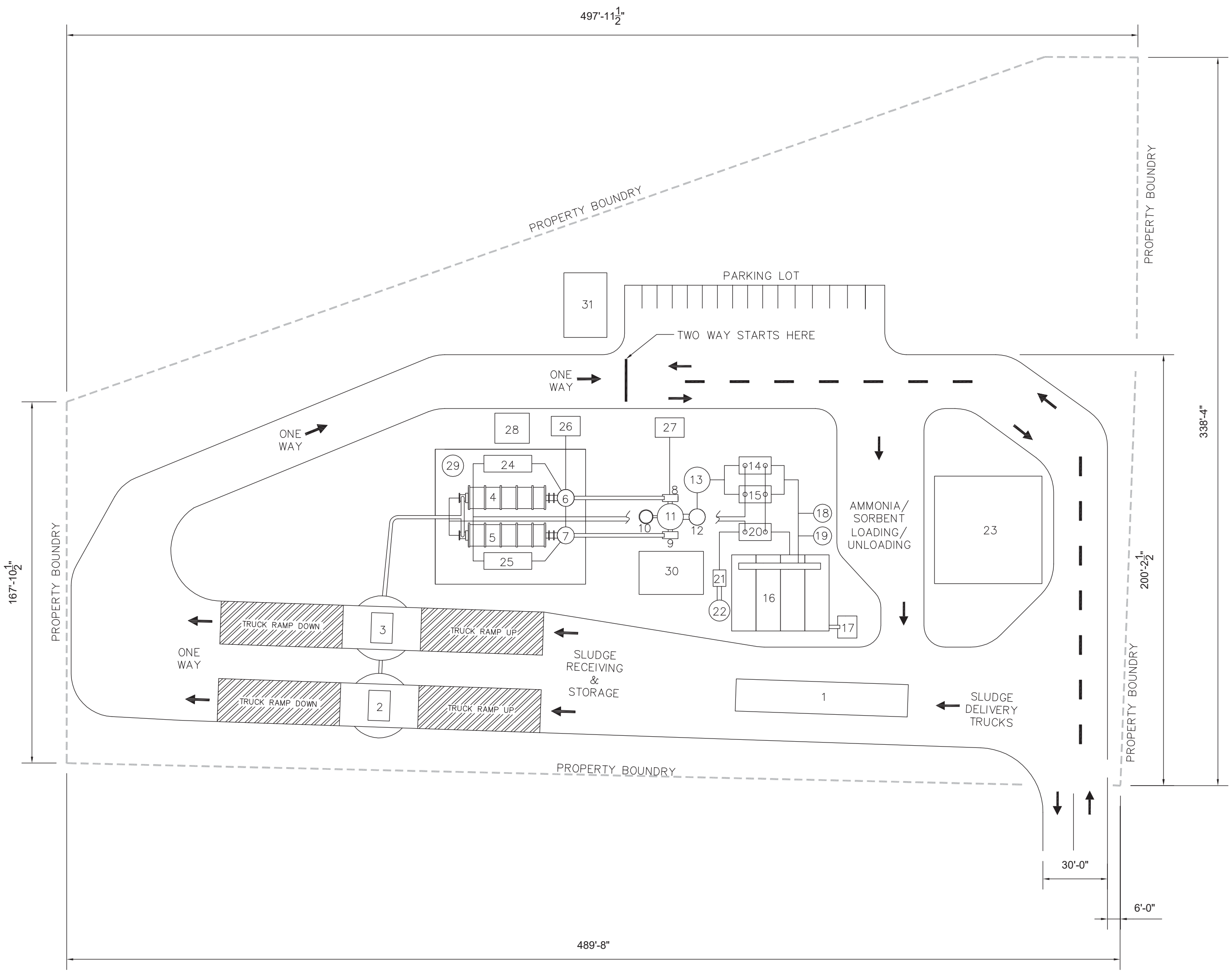
SEPARATELEY ATTACHED SPREADSHEET

G - Newark Gasification Plant - Level 1 Risk Screening - Final.xlsx

EXHIBIT H

EQUIPMENT PLAN FOR NEWARK BIOCHAR PRODUCTION FACILITY

REVISIONS	A	OPTIMIZED PIPING. ADDED EQUIPMENT TABLE. MOVED ALL EQUIPMENT AWAY FROM EASEMENT. BTG/JT/BD 02/27/2020	B	ADJUSTED EQUIPMENT LOCATIONS. BTG/JT/BD 05/08/2020	C	ADJUSTED PROPERTY BOUNDRY. ADDED WEIGHT COLUMN TO EQUIPMENT LIST. BTG/JT/BD 6/11/2020



GENERAL ARRANGEMENT
NEWARK SITE

EQUIPMENT		
NO.	DESCRIPTION	WEIGHT (TONS)
1	TRUCK SCALE	TBD
2	RECEIVING STATION NO.1	TBD
3	RECEIVING STATION NO.2	TBD
4	SLUDGE DRYER NO.1	46
5	SLUDGE DRYER NO.2	46
6	DRYER NO.1 CYCLONE	5
7	DRYER NO.2 CYCLONE	5
8	GASIFIER FEED BIN NO.1	TBD
9	GASIFIER FEED BIN NO.2	TBD
10	GASIFIER SAND BIN	4
11	GASIFIER	67
12	GASIFIER CYCLONE	26
13	THERMAL OXIDIZER	114
14	HEAT EXCHANGER 1A	35
15	HEAT EXCHANGER 1B	35
16	EMISSION CONTROL SYSTEM	TBD
17	EMISSION CONTROL WASTE ROLL OFF BIN	TBD
18	SORBENT STORAGE TANK	TBD
19	AMMONIA STORAGE TANK	TBD
20	HEAT EXCHANGER 2	56
21	I.D. FAN	2
22	STACK	22
23	NITROGEN PLANT	TBD
24	CONDENSER NO.1	17.5
25	CONDENSER NO.2	17.5
26	BIOSOLIDS LOADOUT BIN	TBD
27	BIOCHAR LOADOUT BIN	TBD
28	COOLING TOWER	TBD
29	CONDENSATE TANK	0.5
30	MAINTENANCE SHOP/MCC	TBD
31	ADMIN BUILDING	TBD

0 10' 25' 50' 100'
SCALE

N

NOTES:
1. THIS SITE LAYOUT WAS CREATED BASED UPON THE DIMENSIONS GIVEN FROM A THIRD PARTY. FIELD VERIFICATION OF THE EXISTING SITE DIMENSIONS AND CONDITION WILL NEED TO BE CONDUCTED.

PRELIMINARY
FOR INFORMATION
PURPOSES ONLY

ARIES CLEAN ENERGY®

4037 RURAL PLAINS CIRCLE, SUITE 290 FRANKLIN, TN 37064

NEWARK SITE LAYOUT
NEWARK SLUDGE PROCESSING FACILITY
NEWARK NJ

SCALE: NONE
DRAWN BY: B.GREEN DATE: 11/20/2019
CHECKED BY: J.THORNTON DATE: 11/20/2019
APPROVED BY: B.DAVIS DATE: 11/20/2019
WBS: NA

SIZE D | DWG NO. NEWARK-LAYOUT-01 | REV C

PROJECT# NA | SHEET 1 OF 1

EXHIBIT I

EQUIPMENT DATA SHEETS AND PROCESS SPECIFICATIONS

ARIES CLEAN ENERGY	PROCESS DESIGN SPECIFICATION SHEET	Project No.	NJNE-1806
		Location:	Newark, NJ
		Sheet:	1 of 1

Equipment Name:	**Gasifier**	Equipment No.:	**GA-13501**
Equipment Spec. No:		Number Req'd:	**1**

1	**GENERAL INFORMATION**			
2	Manufacturer:	*	Site Elevation:	**15' above sea level**
3	Model:	*	Wind Load:	**NA**
4	Service:	**Dried Biosolids**	Seismic Requirements:	**Zone 2A**
5	Indoor: **X**	Outdoor:	Area Classification:	**Class I, Division 2**
6	**DESIGN CONDITIONS**			
7	Pressure: **10 psig** at	**1450 °F inside refractory, 600 °F shell**		
8	Vacuum: **-2 psig** at	**20 °F**		
9	Minimum Design Metal Temp:	**20 °F** at **0 psig**	Test Pressure:	**Per Code**
10	Weight of vessel contents:	**61,000 lbs not including refractory lining**		
11	**OPERATING CONDITIONS**			
12	Operating Pressure	**0 psig**	Operating Temperature, °F:	
13			**1250 inside refractory**	
14	**CONSTRUCTION**			
15	Materials of construction:			
16	Shell:	**SA-516 GR 70**	Shell thickness:	**1/2"**
17	Refractory Layer 1:	**AR4**	Refractory Anchors:	**SA-516 GR 70**
18	Refractory Layer 2:	**50-2300**	Vessel Orientation:	**Vertical**
19	**NOTES**			
20	1 **See vessel drawings and nozzle schedule in drawing package.**			
21	2 **Vendor to specify items denoted by *.**			
22	3 **Stress Relief and radiograph required.**			
23	4 **Exterior of vessel must be painted with temperature sensitive paint as specified in materials and surface prep specification.**			
24	5 **Interior of vessel shall have welded supports for refractory as shown in drawing package.**			
25				
26				
27				
28	**REVISION LOG**			

29	REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
30	0	Initial issue for quotation	6/16/2020	HLH		
31						
32						

ARIES CLEAN ENERGY

PROCESS DESIGN SPECIFICATION SHEET

Project No.	NJNE-1806
Location:	Newark, NJ
Sheet:	1 of 1

Equipment Name:	**Rotary Drum Dryer System**	Equipment No.:	**TBD**
Equipment Spec. No:		Number Req'd:	**TBD**

GENERAL INFORMATION

Manufacturer:	**TBD**	Site Elevation:	**15' above sea level**
Model:	**TBD**	Wind Load:	**NA**
Service:	**Sewage Sludge Drying**	SEISMIC REQUIREMENTS:	**Zone 2A**
Indoor: **X** Outdoor:		AREA CLASSIFICATION:	**Class II, Division 2**

DESIGN CONDITIONS

Pressure:	**5 psig** at **1200 °F**	Vacuum:	**-2 psig** at **20 °F**
Minimum Design Metal Temp:	**20 °F** at **0 psig**		

OPERATING CONDITIONS

Feed Rate:	**450 TPD**	Drying Medium:	**Hot Air**
Feed Moisture:	**75-82% MOISTURE**	Air Rate:	*
Outlet Solids Moisture:	**≤ 10% MOISTURE**	Air Inlet Temperature:	*
Outlet Solids Temperature:	**~ 185 ° F**	Air Outlet Temperature:	**~ 185 ° F**

CONSTRUCTION

Materials of construction:	*
Material thickness:	*
Corrosion Allowance:	*

NOTES

1. **Dryer system to include a pug mill, cyclone, and a primary air circulating blower.**
2. **Circulating blower sized for 30" wc static to maintain -15" wc in the dryer and 15" wc to overcome system losses.**
3. **System to be provided with vendor's standard instumentation and controls. Must include inlet and outlet moisture content analyzer with wiring to DCS.**
4. **A Programmable PLC controller with HMI interface to be installed in a local panel to allow manual and complete automatic operation with emergency stop.**
5. **Materials of construction and painting to be vendors standard subject to client review.**
6. **Vendor to specify all items denoted by *.**
7. **Hot air entering dryer is assumed to be at 950 ° F**

Case	Hot Air Mass Flow Entering Dryer, lb/hr	Hot Air Vol Flow Entering Dryer, ACFM
430 tpd, 79% moisture	159,627	94,688
450 tpd, 79% moisture	166,730	98,902
430 tpd, 75% moisture	151,128	89,650
430 tpd, 82% moisture	165,803	98,352
70% Turndown	113,487	67,321
40% Turndown	67,454	40,014
430 tpd, Nat. Gas Drying	159,548	94,637

REVISION LOG

REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
0	Initial issue for quotation	6/16/2020	HLH		

ARIES CLEAN ENERGY

PROCESS DESIGN SPECIFICATION SHEET

Project No.	NJNE-1806
Location:	Newark, NJ
Sheet:	1 of 2

Equipment Name:	**Gasifier Cyclone**	Equipment No.:	**CY-13301**
Equipment Spec. No:		Number Req'd:	**1**

No.	Item	Value	Item	Value
1	**GENERAL INFORMATION**			
2	Manufacturer:	*	Site Elevation:	**15' above sea level**
3	Model:	*	Wind Load:	**NA**
4	Assembled Weight:	*	Seismic Requirements:	**Zone 2A**
5	Service:	**Sand/Ash/Producer Gas**	Area Classification:	**Class I Div 2, Class II Div 2**
6	Indoor: **X**	Outdoor:		
7	**DESIGN CONDITIONS**			
8	Pressure: **10 psig** at	**1450 °F inside refractory, 600 °F shell**		
9	Vacuum: **-2 psig** at	**20 °F**	Minimum Design Metal Temp:	**20 °F** at **0 psig**
10	**OPERATING CONDITIONS**			
11	**GAS CONDITIONS**		**GAS COMPOSITION (mol%)**	
12	Mass Flow Rate, lb/hr:	**22,873**	CH_4	**3.1**
13	Volume Flow Rate; acfm:	**19,420**	H_2O	**7.7**
14	Inlet Pressure, psia:	**14.8**	N_2	**46.3**
15	Inlet Temperature, °F:	**1250**	H_2	**16.1**
16	Gas Density, lb/ft^3:	**0.020**	CO_2	**10.9**
17	Molecular Weight:	**24.3**	CO	**12.6**
18	Viscosity, cP:	**0.039**	NH_3	**2.2**
19			Ar	**0.5**
20	**AMBIENT CONDITIONS**		**SOLIDS LOADING**	
21	Temperature, °F	80	Particles in Gas Stream:	**Sand/Ash/Pure Carbon**
22	Pressure, psia:	14.7	Particle Density, lb/ft^3:	**36.8**
23			Particle Loading, lb/hr:	**2,508**
24			Removal Efficiency:	**90% up to 5 micron**
25	**MECHANICAL**			
26	**CONSTRUCTION**		**DIMENSIONS (See note 7)**	
27	Shell Thickness, in:	*	Barrel Diameter, ft (B):	**6.15**
28	Corrosion Allowance, in:	*	Barrel Height, ft (F):	**12.30**
29	Materials of Construction:	*	Cone Height, ft (E):	**12.30**
30	Refractory Thickness:	*	Total Height, ft (E+F):	**24.60**
31	Refractory Type:	*	Inlet Height, ft (G):	**3.08**
32			Inlet Width, ft:	**1.03**
33			Gas Outlet Diameter, ft (C):	**3.08**
34			Vortex Finder Length, ft:	**3.38**
35			Solids Outlet Diameter, ft (A):	**2.31**
36			Cone Angle, deg:	**81.12**

No.	NOTES
37	**NOTES**
38	1 **Vendor to specify all items denoted by *.**
39	2 **Vendor to provide performance curve and equipment drawings with quote.**
40	3 **Cyclone should have capabilities to remove cone for cleaning and maintenance.**
41	4 **Materials of construction and painting to be vendors recommendation subject to client review.**
42	5 **Refractory type and thickness to be installed per fabrication package.**
43	6 **Vendor to provide pressure drop in cyclone at specified conditions.**
44	7 **See sketch on page 2 for details on dimensions. All dimensions are inside diameter of the refractory.**
45	8 **All surfaces to be lined with 10" thick refractory except for vortex finder.**

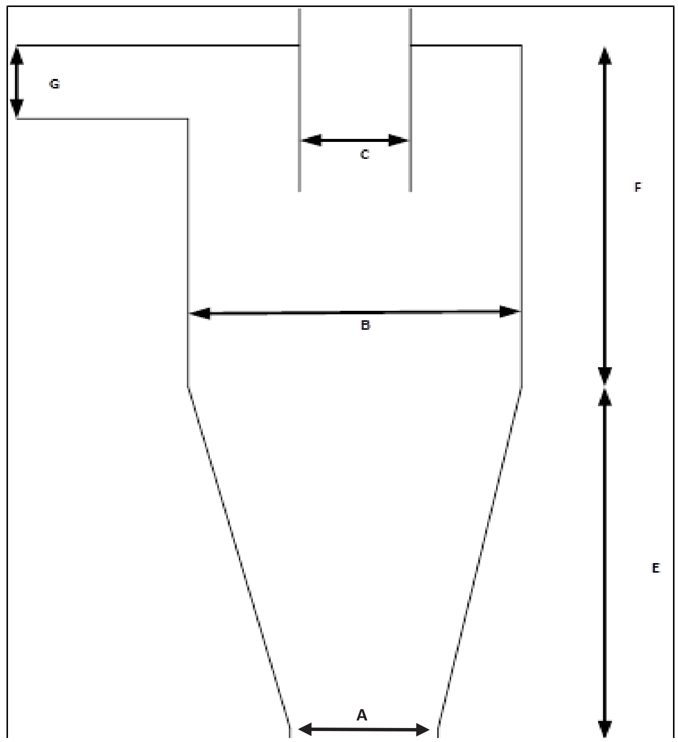
No.	REVISION LOG					
46	**REVISION LOG**					
47	REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
48	0	Initial issue for quotation	6/16/2020	HLH		
49						
50						

PROCESS DESIGN SPECIFICATION SHEET	Project No.	NJNE-1806
	Location:	Newark, NJ
	Sheet:	2 of 2

Equipment Name: **Gasifier Cyclone** Equipment No.: **CY-13301**

Equipment Spec. No: ?? Number Req'd: **1**

EQUIPMENT SKETCH



REVISION LOG

REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
0	Initial issue for quotation	6/16/2020	HLH		

ARIES CLEAN ENERGY

BIOCHAR LOADOUT BIN
DATA SHEET
U.S CUSTOMARY

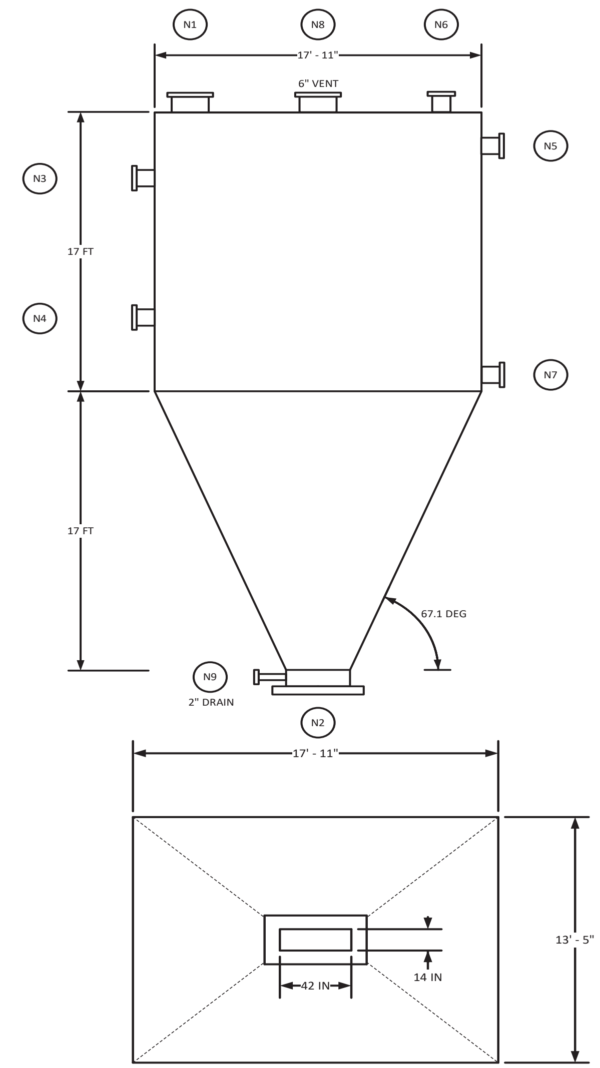
		R
PROJECT NO.	NJNE-1806	
REV / DATE	A / 10-JULY-20	
PAGE NO.	1 OF 1	

1 APPLICABLE TO: ● PROPOSAL ○ PURCHASE ○ AS BUILT PO NO.
2 FOR ARIES CLEAN ENERGY UNIT: BIOCHAR LOADOUT BIN
3 SITE: NEWARK, NJ NO. REQUIRED: 01 EQUIPMENT SPEC. NO.: 100-001
4 SERVICE BIOCHAR STORAGE TO TRUCK LOADOUT EQUIPMENT NO. BN-17701 ORIENTATION: VERTICAL
5 MANUFACTURER: VS* SIZE: I.D: in. X LENGTH/HEIGHT in. CAPACITY: 100 TONS TOTAL
6 THICKNESS: SHELL: VS* in. HEADS: VS* in. SURFACE FINISH: SSPC-SP 10 PAINTING: MANUFACTURER STD.
7 LIFTING LUGS (YES/NO): YES GROUNDING LUGS (YES/NO): YES VORTEX BREAKER (YES/NO): NO LADDER & PLATFORM: VS*

8 **DESIGN DATA**
9 CODE: ASME SECTION VIII, DIV. 1, SECTION II, SECTION IX, AWS D1.1 & B31.3
10 STAMP: NO NAT'L BOARD YES
11 FLUID: BIOCHAR
12 INTERNAL DESIGN PRESSURE: 5 psi(g) @ °F
13 EXTERNAL DESIGN PRESSURE: N/A psi(g) @ °F
14 OPERATING PRESSURE ATMOSPHERIC psi(g) @ °F
15 DESIGN VACUUM -25 OPERATING VACUUM mmHg
16 OPERATING TEMPERATURE: 100 MDMT -20 °F
17 DENSITY 36.8 lb/ft^3 DESIGN TEMEPATURE 300 °F
18 PWHT: PER CODE RADIOGRAPHY: PER CODE
19 OTHER NDE: N/A
20 JOINT EFFICIENCY: SHELL: 0.85 HEADS: 0.85
21 CORROSION ALLOWANCE (in.): VESSEL: 0.125 SUPPORTS: 0.125
22 WIND DESIGN N/A
23 SEISMIC DESIGN: SDS = 0.286, SD1 = 0.113
24 INSULATION TYPE: N/A THICKNESS: N/A in.

TESTING & INSPECTION
LEAK TEST METHOD: ROOF VS* SHELL VS*
NOZZLES VS* MANHOLES VS*
○ MANUFACTURER STD. SURFACE PREPARATION AND PAINT

TYPICAL SKETCH



25 **MATERIAL SPECIFICATIONS**
26 HEADS: SA-516 GR. 70
27 SHELL: SA-516 GR. 70
28 SKIRT / BASE RING / LEGS / LUGS /SADDLES : SA-516 GR. 70
29 NOZZLE NECKS: SA-106-B
30 FLANGES: SA-105
31 REPADS: SA-516 GR. 70
32 GASKETS: SPIRAL WOUND
38 BOLTING: A-193-B7 / A-194-2H

39 **NOZZLE SCHEDULE**

	MARK	SIZE	RATING	TYPE	DESCRIPTION	REMARKS
40	MARK	SIZE	RATING	TYPE	DESCRIPTION	REMARKS
41	N1			RF	INLET NOZZLE	
42	N2	14"X42"		RF	OUTLET NOZZLE	RECT. BOTTOM CHUTE
43	N3			RF	SAMPLING PORT	
44	N4			RF	NITROGEN INLET	
45	N5 & N7			RF	LEVEL SWITCHES	
46	N6			RF	PURGE OUTLET	

47 **FOUNDATION DATA**
48 FABRICATED WEIGHT VS* lb
49 SHIPPING WEIGHT VS* lb
50 LADDER/PLATFORM WEIGHT VS* lb
51 INSULATION WEIGHT VS* lb
52 ERECTION WEIGHT VS* lb
53 EMPTY WEIGHT VS* lb
54 OPERATING WEIGHT VS* lb
55 WIND MOMENT VS* lbf-ft
56 WIND SHEAR VS* lb
57 SEISMIC MOMENT VS* lbf-ft
58 SEISMIC SHEAR VS* lb
59 DESIGN ANCHOR BOLT STRESS VS* psi
60 DESIGN CORR. ALLOW. ON ANCHOR BOLT DIA.: 0.125 in.

61 NOTES: * VENDOR TO SUPPLY
62 [1] VENDOR TO PROVIDE TWO (02) GROUNDING LUGS LOCATED AT 180 DEGREE APART. HYDROTEST PRESSURE SHALL BE 1.5 MAWP.
63 [2] BIOCHAR BIN TO BE EQUIPPED WITH 1' X 1' SQUARE BOTTOM CHUTE SUITABLE TO HAVE A SLIDE GATE OR ROTARY VALVE ATTACHED.
64 [3] VESSEL CAPACITY SHALL BE CONFIRMED DURING DETAILED DESIGN.
65 [4] VENDOR SHALL PROVIDE TWO (02) LIFTING LUGS.
66 [5] VENDOR SHALL PROVIDE ALL DIMENSIONS AND THICKNESSES FOR THE SPECIFIED DESIGN CONDITIONS IN ACCORDANCE WITH ASME SEC. 8, DIV.1.
67 [6] CAPACITY OF BIN IS 100 TONS TOTAL, 85 TONS WORKING
68

			A	B	C		
69	REVISION NUMBER		A	B	C		
70	PROCESS ENGINEER	INITIAL / DATE	HLH / 10-JULY-20				
71	PROCESS APPROVAL	INITIAL / DATE					
72	MECHANICAL ENGINEER	INITIAL / DATE					
73	MECHANICAL APPROVAL	INITIAL / DATE					

ARIES CLEAN ENERGY

PROCESS DESIGN SPECIFICATION SHEET

Project No.	NJNE-1806
Location:	Newark, NJ
Sheet:	1 of 1

Equipment Name:	**Biochar Loadout Bin Induced Draft Fan**	Equipment No.:	**FN-17101**
Equipment Spec. No:		Number Req'd:	**1**

1	**GENERAL INFORMATION**			
2	Service:	**Biochar Particulates**	Site Elevation:	**15' above sea level**
3	Indoor: **X** Outdoor:		Wind Speed (mph):	**NA**
4	Duty:	**Continuous**	Seismic Requirements:	**Zone 2A**
5			Area Classification:	**Class II, Division 2**
6	**DESIGN CONDITIONS**			
7	Pressure:	**5 psig** at **200 °F**	Vacuum:	**-2 psig** at **20 °F**
8	Minimum Design Metal Temp:	**20 °F** at **0 psig**	Fan Housing MAWP (psig):	*
9	**OPERATING CONDITIONS**			
10	Flow Rate (ACFM):	**23**	Specific Heat (BTU/lb°F):	**0.240**
11	Flow Rate (lb/hr):	**100**	Suction Pressure (psig):	**-0.5**
12	Temperature (°F):	**85**	Discharge Pressure (psig):	**1**
13	Density (lb/ft3):	**0.073**	Differential Pressure (psi):	**1.5**
14	Viscosity (cP):	**0.0180**		
15	**PERFORMANCE**			
16	RPM:	*	Efficiency (%):	*
17	Impeller Diameter (in):	*	Shutoff Head (psi):	*
18	Power (BHP):	*		
19	**MECHANICAL**			
20	**FAN**		**DRIVER**	
21	Manufacturer:	*	Manufacturer:	*
22	Type:	*	Enclosure:	**TEFC**
23	Model:	*	Model:	*
24	Decouple Protection:	*	Frame:	*
25	Suction Connection Size (in):	*	Power:	**460 V / 3 Phase / 60 Hz**
26	Discharge Connection Size (in):	*	**GEAR**	
27	Fan Base Weight (ln):	*	Manufacturer:	*
28	Fan Weight (lb):	*	Type:	*
29	Motor Weight (lb):	*	Model:	*
30			**COUPLING**	
31			Manufacturer:	*
32			Type:	*
33			Model:	*
34	**CONSTRUCTION**			
35	Materials of construction			
36	Housing:	*	Shaft:	*
37	Impeller:	*	Bushings:	*
38	Bearings:	*	Base Plate:	*
39	**NOTES**			
40	1 **Design and discharge pressure to be confirmed during detailed design.**			
41	2 **All moving parts must have appropriate safety guarding.**			
42	3 **Materials of construction and painting to be vendors recommendation subject to client review.**			
43	5 **Fan must be designed with 15% margin above specified operating flow.**			
44	6 **Fan Curve must be provided.**			
45	7 **Vendor to specify all items denoted by *.**			
46	**REVISION LOG**			

	REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
47	REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
48	0	Initial issue for quotation	6/15/2020	HLH		
49						

BIOSOLID LOADOUT BIN
DATA SHEET
U.S CUSTOMARY

ARIES CLEAN ENERGY™

PROJECT NO.	NJNE-1806	R
REV / DATE	A / 18-JUNE-2020	B
PAGE NO.	1 OF 1	

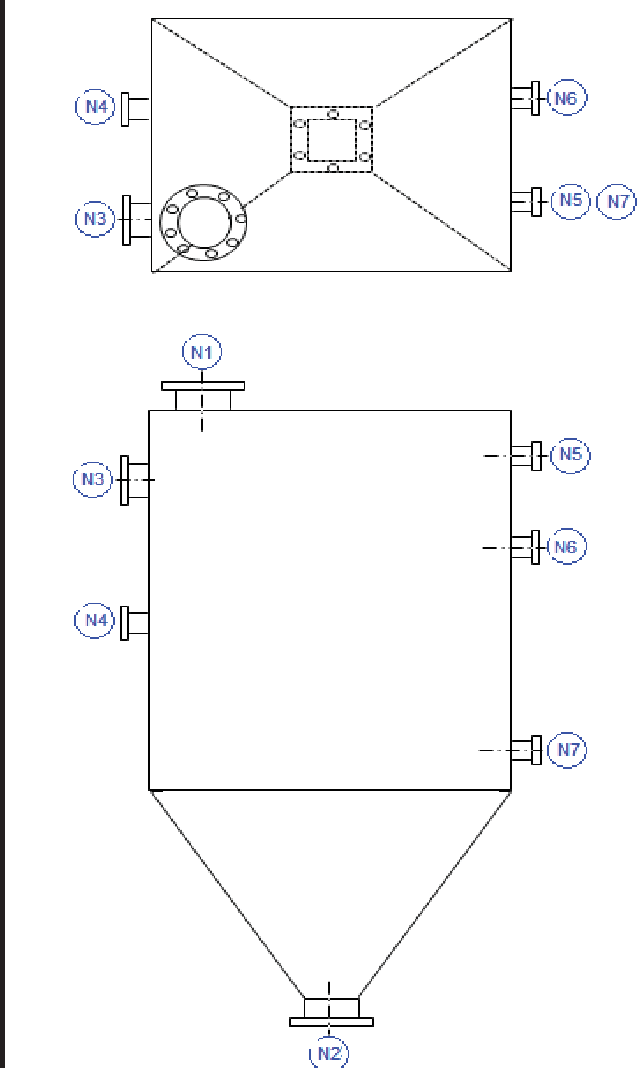
1 APPLICABLE TO: ● PROPOSAL ○ PURCHASE ○ AS BUILT PO NO.
2 FOR: ARIES CLEAN ENERGY UNIT: BIOSOLID LOADOUT BIN
3 SITE: NEWARK, NJ NO. REQUIRED: 01 EQUIPMENT SPEC. NO.: 100-001
4 SERVICE: BIOSOLID STORAGE TO TRUCK LOADOUT EQUIPMENT NO. BN-17705 ORIENTATION: VERTICAL
5 MANUFACTURER: VS* SIZE: I.D: in. X LENGTH/HEIGHT in. CAPACITY: 350 TONS CAPACITY R
6 THICKNESS: SHELL: VS* in. HEADS: VS* in. SURFACE FINISH: SSPC-SP 10 PAINTING: MANUFACTURER STD.
7 LIFTING LUGS (YES/NO): YES GROUNDING LUGS (YES/NO): YES VORTEX BREAKER (YES/NO): NO LADDER & PLATFORM: VS*

8 **DESIGN DATA**
9 CODE: ASME SECTION VIII, DIV. 1, SECTION II, SECTION IX, AWS D1.1 & B31.3
10 STAMP: NO NAT'L BOARD YES
11 FLUID: DRIED BIOSOLID @ ≤ 10% MC
12 INTERNAL DESIGN PRESSURE: 5 psi(g) @ °F
13 EXTERNAL DESIGN PRESSURE: N/A psi(g) @ °F
14 OPERATING PRESSURE: ATMOSPHERIC psi(g) @ °F
15 DESIGN VACUUM: -25 OPERATING VACUUM mmHg
16 OPERATING TEMPERATURE: 183 MDMT -20 °F
17 DENSITY: 30 lb/ft^3 DESIGN TEMEPATURE 250 °F
18 PWHT: PER CODE RADIOGRAPHY: PER CODE
19 OTHER NDE: N/A
20 JOINT EFFICIENCY: SHELL: 0.85 HEADS: 0.85
21 CORROSION ALLOWANCE (in.): VESSEL: 0.125 SUPPORTS: 0.125
22 WIND DESIGN: N/A
23 SEISMIC DESIGN: SDS = 0.286, SD1 = 0.113
24 INSULATION TYPE: N/A THICKNESS: N/A in.

TESTING & INSPECTION

LEAK TEST METHOD: ROOF VS* SHELL VS*
NOZZLES VS* MANHOLES VS*
○ MANUFACTURER STD. SURFACE PREPARATION AND PAINT

TYPICAL SKETCH



25 **MATERIAL SPECIFICATIONS**
26 HEADS: SA-516 GR. 70
27 SHELL: SA-516 GR. 70
28 SKIRT / BASE RING / LEGS / LUGS /SADDLES : SA-516 GR. 70
29 NOZZLE NECKS: SA-106-B
30 FLANGES: SA-105
31 REPADS: SA-516 GR. 70
32 GASKETS: SPIRAL WOUND
38 BOLTING: A-193-B7 / A-194-2H

39 **NOZZLE SCHEDULE**

	MARK	SIZE	RATING	TYPE	DESCRIPTION	REMARKS
41	N1			RF	INLET NOZZLE	
42	N2	1' X 1'		RF	OUTLET NOZZLE	SQUARE BOTTOM CHUTE
43	N3			RF	SPARE	
44	N4			RF	NITROGEN INLET	
45	N5 & N7			RF	LEVEL SWITCHES	
46	N6			RF	PURGE OUTLET	

47 **FOUNDATION DATA**
48 FABRICATED WEIGHT: VS* lb
49 SHIPPING WEIGHT: VS* lb
50 LADDER/PLATFORM WEIGHT: VS* lb
51 INSULATION WEIGHT: VS* lb
52 ERECTION WEIGHT: VS* lb
53 EMPTY WEIGHT: VS* lb
54 OPERATING WEIGHT: VS* lb
55 WIND MOMENT: VS* lbf-ft
56 WIND SHEAR: VS* lb
57 SEISMIC MOMENT: VS* lbf-ft
58 SEISMIC SHEAR: VS* lb
59 DESIGN ANCHOR BOLT STRESS: VS* psi
60 DESIGN CORR. ALLOW. ON ANCHOR BOLT DIA.: 0.125 in.

61 NOTES: * VENDOR TO SUPPLY
62 [1] VENDOR TO PROVIDE TWO (02) GROUNDING LUGS LOCATED AT 180 DEGREE APART.
63 [2] HYDROTEST PRESSURE SHALL BE 1.5 MAWP.
64 [3] VESSEL CAPACITY SHALL BE CONFIRMED DURING DETAILED DESIGN.
65 [4] VENDOR SHALL PROVIDE TWO (02) LIFTING LUGS.
66 [5] VENDOR SHALL PROVIDE ALL DIMENSIONS AND THICKNESSES FOR THE SPECIFIED DESIGN CONDITIONS IN ACCORDANCE WITH ASME SEC. 8, DIV.1.
67 [6] SHELL MAXIMUM DIMENSION L = 15' X W = 15' X H = 33' (SPACE AVAILBALE FOR THIS BIN). 9' CONE SECTION
68 [7] CAPACITY OF BIN IS 350 TONS TOTAL, 300 TONS WORKING

	REVISION NUMBER		A	B	C		
70	PROCESS ENGINEER	INITIAL / DATE	HLH/ 18-JUNE-2020				
71	PROCESS APPROVAL	INITIAL / DATE					
72	MECHANICAL ENGINEER	INITIAL / DATE					
73	MECHANICAL APPROVAL	INITIAL / DATE					

ARIES CLEAN ENERGY

PROCESS DESIGN SPECIFICATION SHEET

Project No.	NJNE-1806
Location:	Newark, NJ
Sheet:	1 of 1

Equipment Name:	Biosolids Loadout Bin Induced Draft Fan	Equipment No.:	FN-12103
Equipment Spec. No:		Number Req'd:	1

1	**GENERAL INFORMATION**			
2	Service:	Biochar Particulates	Site Elevation:	14' above sea level
3	Indoor: X	Outdoor:	Wind Speed (mph):	NA
4	Duty:	Continuous	Seismic Requirements:	Zone 2A
5			Area Classification:	Class II, Division 2
6	**DESIGN CONDITIONS**			
7	Pressure: 5 psig	at 200 °F	Vacuum: -2 psig	at 20 °F
8	Minimum Design Metal Temp:	20 °F at 0 psig	Fan Housing MAWP (psig):	*
9	**OPERATING CONDITIONS**			
10	Flow Rate (ACFM):	23	Specific Heat (BTU/lb°F):	0.240
11	Flow Rate (lb/hr):	100	Suction Pressure (psig):	-0.5
12	Temperature (°F):	85	Discharge Pressure (psig):	1
13	Density (lb/ft3):	0.073	Differential Pressure (psi):	1.5
14	Viscosity (cP):	0.0180		
15	**PERFORMANCE**			
16	RPM:	*	Efficiency (%):	*
17	Impeller Diameter (in):	*	Shutoff Head (psi):	*
18	Power (BHP):	*		
19	**MECHANICAL**			
20	**FAN**		**DRIVER**	
21	Manufacturer:	*	Manufacturer:	*
22	Type:	*	Enclosure:	TEFC
23	Model:	*	Model:	*
24	Decouple Protection:	*	Frame:	*
25	Suction Connection Size (in):	*	Power:	460 V / 3 Phase / 60 Hz
26	Discharge Connection Size (in):	*	**GEAR**	
27	Fan Base Weight (ln):	*	Manufacturer:	*
28	Fan Weight (lb):	*	Type:	*
29	Motor Weight (lb):	*	Model:	*
30			**COUPLING**	
31			Manufacturer:	*
32			Type:	*
33			Model:	*
34	**CONSTRUCTION**			
35	Materials of construction			
36	Housing:	*	Shaft:	*
37	Impeller:	*	Bushings:	*
38	Bearings:	*	Base Plate:	*
39	**NOTES**			
40	1 Design and discharge pressure to be confirmed during detailed design.			
41	2 All moving parts must have appropriate safety guarding.			
42	3 Materials of construction and painting to be vendors recommendation subject to client review.			
43	5 Fan must be designed with 15% margin above specified operating flow.			
44	6 Fan Curve must be provided.			
45	7 Vendor to specify all items denoted by *.			
46	**REVISION LOG**			

	REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
47	REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
48	0	Initial issue for quotation	6/15/2020	HLH		
49						

ARIES CLEAN ENERGY	PROCESS DESIGN SPECIFICATION SHEET	Project No. **NJNE-1806** Location: **Newark, NJ** Sheet: **1** of **2**

Equipment Name: **Cooling Tower** Equipment No.: **CT-19501**

Equipment Spec. No: Number Req'd: **1**

#				
1	**GENERAL INFORMATION**			
2	Manufacturer:	*	Site Elevation:	**15' above sea level**
3	Model:	*	Wind Speed (mph):	**12.0 (max)**
4	Type:	**Induced draft, Cross flow**	Snow Fall (in):	**8.5 (max)**
5	Service:	**Cooling Water**	Seismic Requirements:	**Zone 2A**
6	Indoor:	Outdoor: **X**	Area Classification:	**None**
7	**OPERATING CONDITIONS**			
8	Flow Rate:	**6125 gpm**	Ambient Temperature:	**20-85°F**
9	CW Supply Temperature:	**85°F**	Wet Bulb Temperature:	**75°F**
10	CW Return Temperature:	**98°F**	Dry Bulb Temperature:	**88°F**
11	Cooling Tower Duty:	**39,589,000 BTU/hr**	Evaporation Loss (%):	*
12			Drift Loss (%):	*
13	**MECHANICAL**			
14	**TOWER**		**FAN DRIVER**	
15	No. of Cells:	*	No. of Motors Required:	*
16	No. of Fans per Cell:	*	Manufacturer:	*
17	Total No. of Fans:	*	Type:	**TEFC**
18	Basin Capacity (10 mins @ design flow) (gal):	*	Model:	*
19	Blowdown Loss (% of Circulating Water):	*	Full Load Speed (RPM):	*
20	**FAN**		Power:	**460 V / 3 Phase / 60 Hz**
21	Manufacturer:	*	Rated Power (hp):	*
22	Type:	*	**GEAR**	
23	Model:	*	Manufacturer:	*
24	Diameter (in):	*	Type:	*
25	No. of Blades per Fan:	*	Model:	*
26	Fan Speed (RPM):	*	Speed Ratio:	*
27	Tip Speed (ft/s):	*	AGMA Service Factor:	*
28	Power per Fan (hp):	*	**COUPLING**	
29	Total Power (hp):	*	Manufacturer:	*
30	Fan Static Efficiency (%):	*	Type:	*
31	Fan Total Efficiency (%)	*	Model:	*
32	Design Velocity Pressure (psia):	*	Rated Torque:	*
33	Design Static Pressure (psia):	*		
34	Design Air Exit Temperature (°F):	*		
35	Air Volume / Fan (ACFM):	*		
36	**CONSTRUCTION**			
37	Overall Tower Height (ft):	*	Basin Depth - Curb to Floor (ft):	*
38	Basin Dimensions (LxW) (ft):	*	Number / Size of Connections:	*
39	Nominal Cell Dimensions (LxW) (ft):	*	Total Dynamic Head Above Curb (ft):	*
40	Overall Tower Dimensions (LxW) (ft):	*	Assembled Weight (lb):	*
41	Fan Stack Height (ft):	*	Operating Weight (lb):	*
42	Height from Curb to Fan Stack (ft):	*	Live Load (Fan Deck) (lbs/ft^2):	*
43	Tower Support Method (Steel Beams, Steel Beams on Concrete Piers, etc.):			*
44	**REVISION LOG**			

#	REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
46	0	Initial issue for quotation	6/14/2020	HLH		
47						
48						

ARIES CLEAN ENERGY

PROCESS DESIGN SPECIFICATION SHEET

Project No. **NJNE-1806**
Location: **Newark, NJ**
Sheet: **2** of **2**

Equipment Name: **Cooling Tower** | Equipment No.: **CT-19501**
Equipment Spec. No: **??** | Number Req'd: **1**

49	**CONSTRUCTION (cont'd)**			
44	Materials of construction			
45	Structural Members:	*	Tube Bank:	*
46	Nonstructural Members:	*	Distribution Nozzles:	*
47	Fill:	*	Bolts, Nuts, Washers, Nails:	*
48	Fill Supports:	*	Vibration Control Spring:	*
49	Basin:	*	Joint Connectors:	*
50	Inlet Louvers:	*	Ladder:	*
51	Drift Eliminators / Spacers:	*	Deck:	*
52	Eliminator Support:	*	Fan Stack:	*
53	Distributor Pipe:	*	Drive Shaft/Coupling:	*
54	Distributor Pipe Support:	*	Motor and Gear Support:	*
55	Partition Wall:	*	Foundation:	*
56	Fill:			
57	Description/Type:	*	Vertical/Horizontal Spacing:	*
58	Dimensions (HxWxL):	*	Water Rate:	*
59	Fill Weight (lb):	*	Liquid to Gas Ratio:	*
60	**NOTES**			
61	1 **All moving parts must have appropriate safety guarding.**			
62	2 **Materials of construction and painting to be vendors recommendation subject to client review.**			
63	3 **Cooling tower must be designed with 10% margin.**			
64	4 **Vendor to specify all items denoted by *.**			

PROCESS DESIGN SPECIFICATION SHEET

ARIES CLEAN ENERGY

Project No. NJNE-1806
Location: Newark, NJ
Sheet: 1 of 1

Equipment Name: Emissions Control System | Equipment No.: Multiple
Equipment Spec. No: | Number Req'd: 1

#					
1	**GENERAL INFORMATION**				
2	Manufacturer:	Tri-mer Corporation	Site Elevation:	15' above sea level	
3	Model:	UCF Type 3	Wind Load:	100 mph (3 sec. peak) / 80 mph (min. design)	
4	Service:	Flue Gas Emissions Control	Seismic Requirements:	Zone 2A	
5	Indoor:	Outdoor: X	Area Classification:	Class II, Division 2	
6	**DESIGN CONDITIONS**				
7	Pressure: 5 psig at 900°F		Vacuum: Full Vacuum at 20 °F		
8	Minimum Design Metal Temp:	20 °F at 0 psig			
9	**OPERATING CONDITIONS**				
10	Gas Flow:	112,547 lb/hr	Bulk Gas Composition		
11	Inlet Pressure:	14.7 PSIA	CO_2	6.4	vol %
12	Actual Density:	0.033 lb/ft3	H_2O	10.50	vol %
13	Inlet Temperature		N_2	71.50	vol %
14	Maximum:	750 °F	O_2	10.6	vol %
15	Minimum:	450 °F	Ar	0.85	vol %
16	**CONTAMINANT INFORMATION**				
17	Inlet Stream Contaminants		Desired Removal Efficiencies		
18	NOx	450.9 TPY	NOx	> 95%	
19	SOx	898.5 TPY	SOx	> 96%	
20	PM-10	870.6 TPY	PM-10	> 99%	
21	**SYSTEM INFORMATION**				
22	Housing Type:	VS*	Element Type	VS*	
23	Housing Size:	VS*	Element Size	VS*	
24	Catalyst and Chemical Usage:		Solid Waste:		
25	> Ammonia	VS*	> Spent Sorbent	VS*	
26	> SCR Catalyst	VS*	> Ammonia Slip	VS*	
27	> Sorbent	VS*	> PM	VS*	
28	**CONSTRUCTION**				
29	Materials of Construction:	VS*			
30	Material Thickness:	VS*			
31	Corrosion Allowance:	VS*			
32	**NOTES**				
33	* VENDOR TO SPECIFY				
34	1 Contaminant flows are based on 8,150 operating hours per year				
35	2 Emissions Control System to include emissions control unit and all supporting equipment i.e. fan, chemical storage and transfer, ducting etc.				
36	3 System to be provided with vendor's standard instumentation and controls.				
37	4 Compressed air at 100 psig will be provided by Aries Clean Energy				
38	5 A PLC with HMI interface to be installed in a local panel to allow manual and complete automatic operation with emergency stop.				
39	6 Materials of construction and painting to be vendors standard subject to client review.				
40	7 Vendor to provide operating air flows and temperatures.				
41	8 Trace amounts of HF or HCl may be present in the inlet gas, vendor to consider this when selecting materials.				
42					

REVISION LOG (row 43)

#	REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
45	A	Initial issue for quotation	6/16/2020	HLH		
46	B					
47	C					
48	D					
49	E					

ARIES CLEAN ENERGY

BOLTED TANKS DATA SHEET U.S CUSTOMARY

PROJECT NO.	NJNE-1806	R
REV / DATE	A / 17-JUNE-20	
PAGE NO.	1 of 2	

APPLICABLE TO: ● PROPOSAL ○ PURCHASE ○ AS BUILT PO NO.

MANUFACTURER TBD YEAR BUILT / SERIAL NO. TBD / TBD

SITE NEWARK, NJ NO. REQ'D. TWO (02) EQUIPMENT NUMBER TK-11703 / 11704 EQUIPMENT SPEC. NO. 100-001

CAPACITY (MAX. / NET WORKING)* 940 TONS / 750 TONS TANK (DIA. / HEIGHT)* 27 ft / 48 ft UNIT SLUDGE STORAGE TANK

LIQUID SLUDGE @ 79% MC DESIGN SP. GRAVITY 1.09 @ 60 °F EMERGENCY VACUUM DESIGN (YES / NO) YES SET @ TBD mm Hg

NOTE: * IF BOX IS BLANK, MANUFACTURER SHALL DETERMINE AND SUBMIT.

DESIGN DATA

PURCHASER TO REVIEW DESIGN PRIOR TO ORDERING MATERIAL (YES / NO)

APPLICABLE CODES AND STANDARDS* ■ API 12B ■ API 650

☐ ASME SECTION VIII, DIV 1 ☐ OTHER

MAX. DESIGN TEMP./ DESIGN METAL TEMP. 150 / -20 °F

DESIGN PRESSURE (INTERNAL / EXTERNAL) / PSI

PUMPING RATES: IN OUT ft^3/h

SEISMIC DESIGN (YES / NO) YES ■ API 650 ANNEX E ALTERNATE

■ MAPPED SEISMIC PARAMETERS S_s 0.286 S_1 0.113 S_o

WIND VELOCITY FOR NON-US SITES (50 YR WIND SPEED 3-SEC GUST)*

VENTING*

■ PER API 2000 ☐ OTHER

■ NORMAL VENTING ☐ EMERGENCY VENTING

☐ FLAME ARRESTOR [YES / NO] YES

OTHER TANK APPURTENANCES

PLATFORM, STAIRWAY, AND RAILING: GALVANIZING REQUIRED ■ YES ☐ NO

STAIRWAY STYLE* WALK SURFACE TYPE*

STAIRWAY AND WALKWAY CLEAR WIDTH* in.

NATIONAL SAFETY STANDARD*

ARCHITECTURAL / STRUCTURAL SPECIFICATION*

GAUGER'S PLATFORM REQUIRED ☐ YES ☐ NO QUANTITY REQD.*

PER SPECIFICATION* OSHA AND API

JACKET REQUIRED ☐ YES ■ NO

HEATER / COOLER REQUIRED ■ YES ☐ NO

SUPPLEMENTAL JACKET, HEATER OR COOLER SPECIFICATION* ☐ YES ■ NO

MIXER / AGITATOR: QUANTITY SIZE*

PER SPECIFICATION*

INSULATION REQUIRED ☐ YES ■ NO THK.* MATERIAL*

RESPONSIBILITY FOR INSULATION & INSTALLATION ☐ PURCHASER ☐ MFG.

STRUCTURAL ATTACHMENTS: ☐ LIFTING LUGS ■ GROUNDING LUGS

SHELL ANCHORAGE* ■ YES ☐ NO TYPE*

SCAFFOLD CABLE SUPPORT ☐ YES ■ NO

SHELL

SHELL DESIGN: ■ PER API 650 ■ PER API 12B ☐ OTHER

NUMBER OF SHELL COURSES:

PLATE WIDTHS AND THICKNESSES (INCLUDING CORROSION ALLOWANCE)* - in.

	WIDTH*		THICKNESS*		WIDTH*		THICKNESS*
1.		/		2.		/	
3.		/		4.		/	
5.		/		6.		/	
7.		/		8.		/	
9.		/		10.		/	

BOTTOM

THICKNESS* in. STYLE* ☐ FLATE ☐ CONE

PAINT & COATING

SHELL EXTERIOR ■ YES ☐ NO INTERIOR ■ YES ☐ NO

SURFACE PREPARATION SSPC-SP 6 & 10

BOTTOM UNDERSIDE ☐ YES ■ NO INTERIOR ■ YES ☐ NO

SURFACE PREPARATION SSPC-SP 6 & 10

STRUCT. STEEL EXTERIOR ■ YES ☐ NO INTERIOR ■ YES ☐ NO

SPECIFICATION SSPC-SP 6 & 10

TANK BOTTOM COATING:

INTERIOR ■ YES ☐ NO MATERIAL

APPLICATION SPECIFICATION

ROOF

ROOF TYPE*: ☐ SUPPORTED ☐ SELF-SUPPORTED

ROOF SUPPORT COLUMNS (PIPE/STRUCTURE STEEL)*

ROOF PLATE THICKNESS* in.

ALTERNATIVE ROOF DESIGN* ☐ PER API ANNEX ☐ C ☐ G ☐ H

☐ PER API RP 12R1

OPEN TOP & FIXED ROOF: OPEN TOP (YES / NO)* NO

RAFTERS REQUIRED* ☐ YES ☐ NO

FOUNDATION

FURNISHED BY* OTHERS (NOTE 4) TYPE* STRUCTURAL STEEL

SOIL ALLOWABLE BEARING PRESSURE* PER SPEC.* psi

ANCHOR: SIZE* QUANTITY*

FOUNDATION DESIGN LOADS: WIND* SEISMIC*

OVERTURNING MOMENT: WIND* SEISMIC*

RING FORCES: WEIGHT OF SHELL + ROOF NEW*

CORRODED* ROOF LIVE LOAD*

INTERNAL PRESSURE* PARTIAL VACUUM*

WIND* SEISMIC*

TESTING AND INSPECTION

HYDROTEST ■ YES ☐ NO HYDROTEST FILL HEIGHT* TBD ft

RESPONSIBILITY FOR HEATING WATER (IF REQD.) ☐ PURCHASER ☐ MFG.

SETTLEMENT MEASUREMENTS REQUIRED ☐ YES ☐ NO

EXTENDED DURATION OF HYDRO-TEST TBD

☐ PREDICTED SETTLEMENT PROFILE IS ATTACHED

RESPONSIBILITY FOR SETTING WATER QUALITY ☐ PURCHASER ☐ MFG.

☐ SUPPLEMENTAL TEST WATER QUALITY SPEC. TBD

TEST WATER SOURCE & DISPOSAL TIE0IN LOCATIONS TBD

HYDRO-TEST API 650 ANNEX J TANK ■ YES ☐ NO

POST-PRESSURE TEST ACTIVITIES REQUIRED OF THE MANUFACTURER:

■ BROOM CLEAN ■ PORTABLE WATER RINSE ■ DRY INTERIOR

☐ OTHER

INSPECTION BY TBD IN SHOP; TBD IN FIELD

☐ OTHER TEST* ☐ TENSION TEST ☐ STRIPPING TEST ☐ HEAD TEST

CLEANOUTS

TYPE* ☐ FLUSH ☐ EXTENDED-NECK ☐ OTHER

DIMENSIONS* HEIGHT [IN] WIDTH [IN]

DESIGN MIN. FACTOR OF SAFETY*

CLEANOUT COVER PLATE* ☐ ONE-PIECE ☐ TWO-PIECE

NOTES:

[1] SLUDGE STORAGE TANK SHALL BE EQUIPPED WITH A VENT FOR ODOR CONTROL.

[2] PROVIDE NOZZLE FOR HIGH AND LOW LEVEL SWITCHES.

[3] VENDOR TO SPECIFY ALL INSTRUMENTATION NOZZLES.

[4] TANK ELEVATED 7' FROM THE GRADE SUPPOTED BY STRUCTURAL STEEL (NOT IN THE SCOPE OF SUPPLY)

[5]

[6]

REVISION NUMBER		A	B	C		
PROCESS ENGINEER	INITIAL / DATE	HLH / 17-JUNE-2020				
PROCESS APPROVAL	INITIAL / DATE					
MECHANICAL ENGINEER	INITIAL / DATE					

ARIES CLEAN ENERGY

SHELL AND TUBE HEAT EXCHANGER
DATA SHEET
US CUSTOMARY

#								
1	Client				Project No:	NJNE-1806		
2	Project	Newark Sludge Processing Plant			Specification No:	??		
3	Plant Location	Newark, NJ			Rev / Date:	A / 14-June-20		
4	Equipment No:	HX-14502/14503			Page No:	1 of 2		
5	Service of Unit	Heat Recovery 1			No. of Units Req'd:	Two		
6	Size	VS* inch x VS* ft	Type	TEMA (Horizontal) - VS*	Connected In	VS* Parallel	VS*	Series
7	Surface / Unit (Gross / Eff)	VS* ft^2	Shell / Unit	VS*	Surface / Shell (Gross / Eff)	VS*	ft^2	

#	PERFORMANCE OF ONE UNIT	Unit	Shell Side (In)	Shell Side (Out)	Tube Side (In)	Tube Side (Out)
8						
9	Fluid Allocation		Shell Side		Tube Side	
10	Fluid Name		Air		Flue Gas	
11	Fluid Quality, Total	lb/h	87,795 (79,813 X 1.1)		56,274 (51,158 X 1.1)	
12	Vapor (In/Out)	lb/h	87,795 (79,813 X 1.1)	87,795 (79,813 X 1.1)	56,274 (51,158 X 1.1)	56,274 (51,158 X 1.1)
13	Liquid (In/Out)	lb/h				
14	Steam (In/Out)	lb/h				
15	Water (In/Out)	lb/h				
16	Non-Condensable	lb/h				
17	Temperature (In/Out)	°F	159.5	950.0	1,800.0	700.0
18	Density, Liquid / Vapor	lb / ft^3	- / 0.065	- / 0.028	- / 0.017	- / 0.034
19	Viscosity, Liquid / Vapor	cP	- / 0.020	- / 0.037	/ 0.0500	- / 0.0320
20	Molecular Weight, Liquid / Vapor		- / 28.2	- / 28.2	- / 28.6	- / 28.60
21	Molecular Weight, Non-Condensable		- /	- /	- / -	- /
22	Specific Heat, Liquid / Vapor	Btu/lb-F	- / 0.250	- / 0.272	- / 0.307	- / 0.271
23	Thermal Cond., Liquid / Vapor	Btu/hr-ft-F	- / 0.017	- / 0.033	- / 0.05	- / 0.028
24	Latent Heat	Btu / lb				
25	Inlet Pressure	psig	20 in WC		2 in WC	
26	Velocity	ft/sec	VS*		VS*	
27	Pressure Drop, Allowable / Calc	psi	10 in. WC		5 in WC	
28	Fouling Resistance (min)	hr-ft^2-F/Btu	0.0005		0.003	
29	Heat Exchanged	18,000,656 (16,364,233 X 1.1) Btu/hr	MTD (Corrected) VS* °F		MDMT -20 °F	
30	Transfer Rate, Service	VS*	Dirty VS*		Clean VS*	Btu / hr-ft^2-F

#	CONSTRUCTION OF ONE SHELL	Unit	Shell Side	Tube Side	Sketch (Bundle / Nozzle Orientation)
31					
32			Shell Side	Tube Side	
33	Design / Test Pressure	psig	10 / Code	10 / Code	
34	Design Temperature	°F	1200.0	2000.0	
35	No Passes per Shell				See Page 2 of 2 for Sketch (VS*)
36	Corrosion Allowance	inch	0.0625	0.0625	
37	Connection	In inch	See Nozzle Schedule on page 2 of 2		
38	Size &	Out inch			
39	Rating	Others inch			
40	Tube No. VS*	OD VS* inch	Thk(Avg) VS* inch	Length VS* ft	Pitch VS* inch Layout VS* °
41	Tube Type			Material	VS*
42	Shell	VS*	ID inch	Shell Cover	VS*
43	Channel or Bonnet	VS*		Channel Cover	VS*
44	Tubesheet-Stationary	VS*		Tubesheet-Float	
45	Floating Head Cover	VS*		Impingement Plate	
46	Baffles-Cross	VS*	%Cut (Diam) VS*	Spacing(c/c)	Inlet/Outlet inch
47	Baffles-Long		Seal Type		
48	Supports-Tube		U-Bend	Type	
49	Bypass Seal Arrangement		Tube-Tubesheet Joint		
50	Expansion Joint		Type		
51	Rho-V^2-Inlet Nozzle	VS*	Bundle Entrance	Bundle Exit	lb/ft-sec2
52	Gaskets-Shell Side		Tube Side		
53	Code Requirements	ASME SEC VIII, DIV 1, TEMA & API 660	Code Stamp (Yes / No) No	TEMA Class	R
54	Weight/Shell	VS*	Filled with Water VS*	Bundle VS*	lb

55 **NOTES:** * VENDOR TO SPECIFY

56 [1] Vendor shall evaluate the design for acoustic vibration. Supplier shall include deresonating baffles if needed to prevent acoustic vibration

57 [2] Vendor shall consider an impingement plate, to protect the tube bundle against impinging fluids

58 [3] Vendor to recommend TEMA type, subject to client approval.

59 [4] Nozzle sizing to be determined during detailed design. Additional nozzles for drains, instrumentation, or relief valves may be required.

60 [5] Vendor to verify materials of construction to meet process design conditions.

61 [6] Vendor shall consider floating head and removable bundle.

62 [7] Vendor shall consider 200 lb/hr ash in the flue gas and also the potential for HCl and HF, to protect the tube bundle against rapid tube fouling.

#	REVISION NO:		A	B	C	0	
64	PROCESS ENGINEER	INITIAL / DATE	HLH / 14-June-20				
65	PROCESS APPROVAL	INITIAL / DATE					
66	MECHANICAL ENGINEER	INITIAL / DATE					
67	MECHANICAL APPROVAL	INITIAL / DATE					

SHELL AND TUBE HEAT EXCHANGER
DATA SHEET
US CUSTOMARY

ARIES CLEAN ENERGY

1	Client		Project No:	NJNE-1806
2	Project	Newark Sludge Processing Plant	Specification No:	??
3	Plant Location	Newark, NJ	Rev / Date:	A / 14-June-20
4	Equipment No:	HX-14504	Page No:	1 of 2
5	Service of Unit	Heat Recovery 2	No. of Units Req'd:	One

6	Size	VS*	inch x	VS*	ft	Type	TEMA (Horizontal) - VS*	Connected In	VS*	Parallel	VS*	Series
7	Surface / Unit (Gross / Eff)	VS*	ft^2	Shell / Unit	VS*			Surface / Shell (Gross / Eff)	VS*			ft^2

8	**PERFORMANCE OF ONE UNIT**					
9	Fluid Allocation		**Shell Side**		**Tube Side**	
10	Fluid Name		Air		Flue Gas	
11	Fluid Quality, Total	lb/h	175,590 (159,627 X 1.1)		112,648 (102,408 X 1.1)	
12	Vapor (In/Out)	lb/h	175,590 (159,627 X 1.1)	175,590 (159,627 X 1.1)	112,648 (102,408 X 1.1)	112,648 (102,408 X 1.1)
13	Liquid (In/Out)	lb/h				
14	Steam (In/Out)	lb/h				
15	Water (In/Out)	lb/h				
16	Non-Condensable	lb/h				
17	Temperature (In/Out)	°F	110.3	159.5	650.0	587.7
18	Density, Liquid / Vapor	lb / ft^3	- / 0.072	- / 0.065	- / 0.033	- / 0.035
19	Viscosity, Liquid / Vapor	cP	- / 0.019	- / 0.02	/ 0.0310	- / 0.0290
20	Molecular Weight, Liquid / Vapor		- / 28.2	- / 28.2	- / 28.4	- / 28.4
21	Molecular Weight, Non-Condensable		- /	- /	- / -	- /
22	Specific Heat, Liquid / Vapor	Btu/lb-F	- / 0.25	- / 0.25	- / 0.270	- / 0.267
23	Thermal Cond., Liquid / Vapor	Btu/hr-ft-F	- / 0.015	- / 0.017	- / 0.0268	- / 0.250
24	Latent Heat	Btu / lb				
25	Inlet Pressure	psig	26 in. WC		-25 in. WC	
26	Velocity	ft/sec	VS*		VS*	
27	Pressure Drop, Allowable / Calc	psi	10 in. WC		5 in.WC	
28	Fouling Resistance (min)	hr-ft^2-F/Btu	0.0005		0.0005	

29	Heat Exchanged	2,159,177 (1,962,888 X 1.1)	Btu/hr	MTD (Corrected)	VS*	°F	MDMT -20	°F
30	Transfer Rate, Service	VS*	Dirty	VS*	Clean	VS*		Btu / hr-ft^2-F

31	**CONSTRUCTION OF ONE SHELL**				**Sketch (Bundle / Nozzle Orientation)**
32			**Shell Side**	**Tube Side**	
33	Design / Test Pressure	psig	10 / Code	10 / Code	
34	Design Temperature	°F	450.0	800.0	
35	No Passes per Shell				See Page 2 of 2 for Sketch (VS*)
36	Corrosion Allowance	inch	0.0625	0.0625	
37	Connection Size & Rating	In inch	See Nozzle Schedule on page 2 of 2		
38		Out inch			
39		Others inch			

40	Tube No.	VS*	OD	VS*	inch	Thk(Avg)	VS*	inch	Length	VS*	ft	Pitch	VS* inch	Layout	VS* °

41	Tube Type		Material	VS*
42	Shell	VS* ID inch	Shell Cover	VS*
43	Channel or Bonnet	VS*	Channel Cover	VS*
44	Tubesheet-Stationary	VS*	Tubesheet-Float	
45	Floating Head Cover	VS*	Impingement Plate	

46	Baffles-Cross	VS*	%Cut (Diam)	VS*	Spacing(c/c)	Inlet/Outlet inch
47	Baffles-Long		Seal Type			
48	Supports-Tube		U-Bend		Type	
49	Bypass Seal Arrangement		Tube-Tubesheet Joint			
50	Expansion Joint		Type			
51	Rho-V^2-Inlet Nozzle	VS*	Bundle Entrance		Bundle Exit	lb/ft-sec2
52	Gaskets-Shell Side		Tube Side			
53	Code Requirements	ASME SEC VIII, DIV 1, TEMA & API 660	Code Stamp (Yes / No)	No	TEMA Class	R
54	Weight/Shell	VS*	Filled with Water	VS*	Bundle	VS* lb

55	**NOTES:** * VENDOR TO SPECIFY
56	[1] Vendor shall evaluate the design for acoustic vibration. Supplier shall include deresonating baffles if needed to prevent acoustic vibration
57	[2] Vendor shall consider an impingement plate, to protect the tube bundle against impinging fluids
58	[3] Vendor to recommend TEMA type, subject to client approval.
59	[4] Nozzle sizing to be determined during detailed design. Additional nozzles for drains, instrumentation, or relief valves may be required.
60	[5] Vendor to verify materials of construction to meet process design conditions.
61	[6] Vendor shall consider floating head and removable bundle.
62	

63	REVISION NO:		A	B	C	0	
64	PROCESS ENGINEER	INITIAL / DATE	HLH / 14-June-20				
65	PROCESS APPROVAL	INITIAL / DATE					
66	MECHANICAL ENGINEER	INITIAL / DATE					
67	MECHANICAL APPROVAL	INITIAL / DATE					

ARIES CLEAN ENERGY

CENTRIFUGAL FANS DATA SHEET

U.S CUSTOMARY

PROJECT NO.	NJNE-1806	R
REV / DATE	A / 15-JUNE-20	
PAGE NO.	1 of 1	

APPLICABLE TO: ● PROPOSAL ○ PURCHASE ○ AS BUILT — PO NO.

FOR — UNIT: EXHAUST STACK INDUCED DRAFT FAN

SITE: NEWARK, NJ — NO. REQUIRED: ONE (01) — EQUIPMENT SPEC. NO.: ??

SERVICE: FLUE GAS — EQUIPMENT NUMBER: FN-14102 — TYPE /ARRANGEMENT: VS* / VS*

MANUFACTURER — SIZE: VS* — MODEL / SERIAL NO.: VS* / VS*

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER □ BY MANUFACTURER

OPERATING CONDITIONS

- GAS HANDLE: FLUE GAS
- GAS COMPOSITION:
- **INLET CONDITIONS:**
  - ● PRESSURE [psia]: 13.73
  - ● TEMPERATURE[°F]: 645
  - ● VOLUME FLOW [SCFM]: 24,375 SCFM DRY (117,769 LB/HR WET)
- **DISCHARGE CONDITIONS:**
  - ● PRESSURE [psia]: 15.7
  - ○ TEMPERATURE[°F]:
  - ○ DENSITY [LB/FT³]: 0.035 ○ VISCOSITY [cP]: 0.029 SP. HEAT: 0.267
- **PERFORMANCE**
  - ■ FAN SPECIFIC SPEED [rpm]:
  - ■ TIP SPEED [ft/sec]:
  - ■ RATED CAPACITY [SCFM]:
  - ■ MECHANICAL EFFICIENCY [%]:

SITE CONDITIONS

- **LOCATION** ● INDOOR ○ OUTDOOR
- ● ELECTRICAL AREA — CLASS — GROUP — DIV
- ○ HEATED ● UNHEATED ○ UNDER ROOF
- ○ WINTERIZATION REQD ○ TROPICALIZATION REQD
- **SERVICE** ● CONTINOUS ○ INTERMITTENT ○ STANDBY
- **SITE DATA** ● ELEVATION: 15 ASL — MDMT: -20 [°F]
- ○ WIND SPEED [mph] — SEISMIC ZONE: 2A
- **UNUSUAL CONDITIONS**
- ● DUST ○ FUMES ○ OTHER
- **NOISE SPECIFICATION**
- ACOUSTIC HOUSING ○ YES ○ NO ● OTHER
- ● ALLOWABLE NOISE LIMIT: 85 dBA @ 3 FT

■ CONSTRUCTION AND MATERIALS

- ROTATION, VIEWED FROM DRIVEN END:
- ■ **CASING:** MODEL — CASING SPLIT
  - PRESSURE (MAX. WORKING/MAX. DESIGN): / [psig]
  - OPERATING TEMPERATURE (MAX./MIN.): / [°F]
  - HYDRO-TEST [psig] — MATERIAL
- ■ **IMPELLERS:** NUMBER OF IMPELLERS
  - DIAMETERS: 1ST STAGE — 2ND STAGE
  - 3DR STAGE — 4RTH STAGE
  - TYPE (OPEN, RADIAL, BACKWARD LEANING, ETC.)
  - TYPE FABRICATION
  - MATERIAL — COATING TYPE
- ■ **BEARING HOUSING CONSTRUCTION:** MATERIAL
- ■ **RADIAL BEARING:** PINION: NO. EACH — TOTAL
  - TYPE — MAX.(ALLOW ACT) LOAD
  - MAX. LOAD — ACTUAL — ALLOWABLE
  - NO. BULL GEAR — SPAN [in.]
  - AREA [ft²]
  - LOAD [psi] — ACTUAL — ALLOWABLE
- ■ **SHAFT:** MATERIAL
  - DIA. @ GEAR [in.] — COUPLING [in.]
  - SHAFT END: ○ TAPERED ○ CYLINDRICAL
  - SHAFT SLEEVES: ○ AT SHAFT SEALS ○ MATL.
- ■ **LABYRINTHS:** MATERIAL
  - TYPE — SHAFT SEAL TYPE
- ■ **BULL GEARS:** MIN. AGMA SERVICE FACTOR
  - ACTUAL S.F — GEAR RIM MATERIAL
  - GEAR FACE WIDTH — GEAR CENTER MATERIAL
  - HARDNESS — MECHANICAL EFFICIENCY [%]
  - AGMA QUALITY — PITCH DIAMETER
  - PITCH LINE VELOCITY

(Right column)

- ■ **PINIONS:** NO. — MATERIAL
  - SERVICE FACTOR — HARDNESS
- ■ **THRUST BEARINGS:** MIN. AGMA SERVICE FACTOR
  - LOCATION — TYPE
  - AREA [in²] — MANUFACTURER
  - LOADING (ACTUAL / ALLOWABLE): / [psi]
  - GAS LOADING [lb] — COUPLING SLIP LOAD [lb]
- ■ **COUPLINGS:** MAKE / MODEL /
  - LUBRICATION — MOUNT COUPLING HALVES
  - LIMITED END FLOAT REQUIRED
  - COUPLING RATING [hp/100 rpm]

DRIVE DATA

MOTOR

- ○ IEEE 841 ● API 541 ○ API 546 ○ OTHER
- ASD SUPPLIED BY ○ PURCHASER ● MOTOR SUPPLIER
- ■ MANUFACTURER — ■ TYPE
- □ FRAME — ■ ENCLOSURE: TEFC
- ■ LOCATION (FEED / DISCHARGE)
- ■ (HP) — ■ (RPM)
- ● VOLTS: 460 — PHASE: 3 — HERTZ: 60 — SERVICE FACTOR
- ○ VARIABLE SPEED RANGE (RPM)
- ○ MINIMUM STARTING VOLTAGE
- ○ INSULATION — ○ TEMP RISE
- ■ FULL LOAD AMPS
- □ LOCKED ROTOR AMPS
- ■ STARTING METHOD
- □ LUBE
- BEARINGS (TYPE / NUMBER):
  - ■ RADIAL /
  - ■ THRUST /
- SHOP INSPECTION & TESTING: ● PER NEMA ○ MFR STD.
- ○ IMMERSION TEST ○ SPECIAL TEST
- SPACE HEATER ○ YES ● NO
- VFD REQUIRED: ● YES ○ NO
- VFD SUPPLIED BY ○ PURCHASER ● VENDOR ○ OTHERS

TESTING (PER API 673)

Test	Required	Witness
● SHOP INSPECTION & TEST	● REQUIRED	○ WITNESS
○ HYDRO-TEST	○ REQUIRED	○ WITNESS
● MECHANICAL RUN TEST	● REQUIRED	○ WITNESS
● PERFORMANCE TEST	○ REQUIRED	● WITNESS
● CONTROL PANEL FUNCTIONAL TEST	○ REQUIRED	● WITNESS

FAN MANUFACTURER SHALL FURNISH THE FOLLOWING:

- ● FAN
- ● COMMON BASEPLATE UNDER GEAR & DRIVER
- ● DRIVER ● MOTOR ○ OTHER
- ● COUPLING AND GUARD ● GUARDS FOR ALL MOVING PARTS
- ○ LUBE OIL SYSTEM
- ○ SOLE PLATE FOR BEARING PEDESTALS
- ○ INLET SCREEN
- ○ INLET GUIDE VANES ○ BLOWOFF SILENCER
- ○ DUAL CONTROL ○ DISCHARGE CHECK VALVE
- ○ MANUAL / AUTO CONTROL ○ AUTOMATIC CONDENSATE TRAP
- ○ OUTLET LOUVER DAMPERS ○ COOLING WATER MANIFOLD
- ○ BLOWOFF VALVE ○ EXPANSION JOINT

● PAINTING

● MANUFACTURER STD. ○ OTHER

● SHIPMENT

● DOMESTIC ○ EXPORT ○ EXPORT BOXING REQUIRED

○ OUTDOOR STORAGE OVER SIX MONTHS

NOTE: FAN SPECIFIED FLOWRATE INCLUDES 15% MARGIN OVER REQURIED FLOW

REVISION NUMBER		A	B	C		
PROCESS ENGINEER	INITIAL / DATE	HLH / 15 JUNE 20				
PROCESS APPROVAL	INITIAL / DATE					
MECHANICAL ENGINEER	INITIAL / DATE					

ARIES CLEAN ENERGY	PROCESS DESIGN SPECIFICATION SHEET	Project No.	NJNE-1806
		Location:	Newark, NJ
		Sheet:	1 of 1

Equipment Name:	Exhaust Stack	Equipment No.:	ST-14601
Equipment Spec. No:		Number Req'd:	1

GENERAL INFORMATION

Manufacturer:	VS*	Installation Elevation:	15' above sea level
Model:	VS*	Wind Speed, mph:	12.0 (max)
Assembled Weight:	VS*	Snow Fall, in:	8.5 (max)
Service:	Flue Gas Exhaust	Seismic Requirements:	Zone 2A
Indoor: X (See notes)	Outdoor: X	Area Classification:	Class I Div 2, Class II Div 2

DESIGN CONDITIONS

Pressure:	5 psig	at	800 °F	
Minimum Design Metal Temp:	20 °F	at	0 psig	

OPERATING CONDITIONS

GAS FLOW TO STACK			GAS COMPOSITION TO STACK (WET)	
Minimum, ACFM:	10,676		CO_2 (vol%)	3.9 - 10.4
Maximum, ACFM:	51,882		H_2O (vol%)	11.0 - 16.7
Inlet Pressure, psia:	15.7		N_2 (vol%)	67.9 - 72.3
Vapor Density, lb/ft^3:	0.036-0.061		O_2 (vol%)	4.2 - 11.6
Inlet Temperature, °F	216 - 694		Ar (vol%)	0.8
			NOx (ppmV)	30
AMBIENT CONDITIONS			NH_3 (ppmV)	50
	INDOOR	OUTDOOR	SOx (ppmV)	35
Temperature, °F	65	20-85	CO (ppmV)	0
Pressure, psia:	14.7	14.7	H_2 (ppmV)	0
			Ash (mass%)	0.001

MECHANICAL

CONSTRUCTION		DIMENSIONS	
Shell Thickness, in:	VS*	Stack Height, ft:	VS*
Corrosion Allowance, in:	VS*	Stack Diameter, ft:	VS*
Stack Configuration:	VS*	Gas Inlet Nozzle (Type/Size/Location):	VS*
Materials of Construction:		Sample Nozzle (Type/Size/Location):	VS*
Shell	304SS	Drain Nozzle (Type/Size/Location):	VS*
Stack Base Plate	CS with SS repad to shell	Access Door (Size/Location):	VS*
Lateral Support	CS with SS repad to shell		
Drain	304SS	Exhaust Discharge Direction:	UPWARD
Lifting Lugs	CS with SS repad to shell		

NOTES

* VENDOR TO SPECIFY

[1] EXHAUST STACK DESIGN SHALL MEET THE GUIDELINES SPECIFIED IN ASME STS-1.

[2] EXHAUST STACK DESIGN SHALL MEET WIND NORM GUIDELINES SPECIFIED IN ASCE-07-10.

[3] WELDING SHALL MEET THE REQUIREMENTS OF AWS STANDARDS.

[4] VENDOR SHALL PROVIDE THE LOADS IMPOSED UPON THE STACK FOUNDATION PER ASCE-7-10 GUIDELINES.

[5] MATERIALS OF CONSTRUCTION AND PAINTING TO BE VENDORS RECOMMENDATION SUBJECT TO CLIENT REVIEW.

[6] PLATFORMS/ACCESS TO SAMPLE NOZZLES SHALL BE PROVIDED BY VENDOR.

REVISION LOG

REVISION	ISSUE STATUS	DATE	BY	CHECKED	APPROVED
A	Initial issue for quotation	6/16/2020	HLH		

ARIES CLEAN ENERGY

THERMAL OXIDIZER DATA SHEET
U.S CUSTOMARY

PROJECT NO.	NJNE-1806	
REV / DATE	A 16-JUNE-20	R
PAGE NO.	1 of 1	

APPLICABLE TO: ● PROPOSAL ○ PURCHASE ○ AS BUILT — PO NO.

FOR — SERVICE: PRODUCER GAS / NATURAL GAS

SITE: NEWARK, NJ — EQUIPMENT SPEC. NO.

NO. REQUIRED: ONE (01) — EQUIPMENT NUMBER: TO-14501 — EQUIPMENT NAME: THERMAL OXIDIZER

MANUFACTURER — SIZE — MODEL / SERIAL NO. /

NOTE: ○ INDICATES INFORMATION TO BE COMPLETED BY PURCHASER □ BY MANUFACTURER

OPERATING CONDITIONS

	CASE 1	CASE 2	CASE 3
● TOTAL FLOW [lb/hr]	112,547	112,757	117,108
● PRODUCER GAS FLOW [lb/hr]	22,873	0	19,606
● NATURAL GAS FLOW[lb/hr]	0	2476	453
● AIR FLOW [lb/hr]	89,675	110,281	116,655
● AIR DENSITY [lb/ft^3]	0.075	0.075	0.075
● AIR MOLECULAR WEIGHT	28.6	28.6	28.6
● AIR TEMPERATURE [°F]	98.3	98.7	98.7

● PRODUCER GAS TEMPERATURE [°F]: 1250

○ NATURAL GAS TEMPERATURE [°F]:

● TARGET OUTLET TEMPERATURE [°F]: 1800

● PRODUCER GAS DENSITY [lb/ft^3]: 0.020

● PRODUCER GAS MOLECULAR WEIGHT: 24.3

● PRODUCER GAS OPERATING PRESSURE [psig]: 4 in WC

SITE CONDITIONS

LOCATION ● INDOOR ○ OUTDOOR

● ELECTRICAL AREA — CLASS I — GROUP C & D — DIV 2

○ HEATED ● UNHEATED ○ UNDER ROOF

○ WINTERIZATION REQD ○ TROPICALIZATION REQD

SERVICE ● CONTINOUS ○ INTERMITTENT ○ STANDBY

SITE DATA ● ELEVATION: 15' ABOVE SEA LEVEL

○ WIND SPEED [fps]

● SEISMIC REQUIREMENTS: ZONE 2A

○ BAROMETER [in. Hg]

● AMBIENT TEMPERATURE (MIN. / MAX.): 20 / 90 [°F]

○ RELATIVE HUMIDITY (MIN. / MAX.): /

UNUSUAL CONDITIONS

● DUST ○ FUMES ○ OTHER

NOISE SPECIFICATION

ACOUSTIC HOUSING ○ YES ● NO ○ OTHER

● ALLOWABLE NOISE LIMIT: 85 dBA @ 3 ft

DESIGN CONDITIONS

DESIGN PRESSURE [psig]: 10 @ 2000 [°F]

DESIGN TEMPERATURE [°F]: 2000

MINIMUM DESIGN METAL TEMPERATURE [°F]: -20

OVERDESIGN (%): ALL FLOWRATES INCLUDE A 10% MARGIN

CONSTRUCTION

MATERIALS OF CONSTRUCTION:

■ SHELL: VS*

■ REFRACTORY: VS*

■ CORROSION ALLOWANCE: VS*

■ SHELL THICKNESS: VS*

DIMENSIONS

■ VESSEL INTERNAL DIAMETER [in.]: VS*

■ VESSEL HEIGHT [in.]: VS*

● VESSEL ORIENTATION: VERTICAL

GAS COMPOSITION (MASS %)

CH4	3.14
H2	16.11
H2S	0.35
NH3	2.24
HCN	0.16
COS	0.01
H2O	7.67
O2	0.00
N2	46.26
CO	12.61
CO2	10.9
ARGON	0.55

● PAINTING

● MANUFACTURER STD. ○ OTHER

● SHIPMENT

● DOMESTIC ○ EXPORT ○ EXPORT BOXING REQUIRED

○ OUTDOOR STORAGE OVER SIX MONTHS

■ WEIGHTS

EMPTY LBS — SHIPPING LBS

OPERATING LBS

NOZZLE SCHEDULE

MARK	SERVICE	SIZE	SCHEDULE	FLANGE TYPE	FLANGE CLASS	GASKET BEARING SURFACE, DIMENSION & FINISH	GASKET THICKNESS & DIMENSION	GASKET MATERIAL & DESCRIPTION	DESCRIPTION

NOTES:

[1] SYSTEM TO BE PROVIDED WITH VENDOR'S STANDARD INSTRUMENTATION AND CONTROLS.

[2] BURNER MANAGEMENT SYSTEM WITH DCS INTERFACE TO BE INSTALLED IN A LOCAL PANEL TO ALLOW MANUAL AND COMPLTE AUTOMATIC OPERATION WITH EMERGENCY SHUTDOWN.

[3] VENDOR SHALL CONSIDER 200 LB/HR ASH IN THE PRODUCER GAS.

[4] VENDOR SHALL CONSIDER 40-50 PPM HCL AND 5 PPM OF HF IN THE PRODUCER GAS.

[5]

[6]

[7]

[8]

[9]

REVISION NUMBER		A	B	C		
PROCESS ENGINEER	INITIAL / DATE	HLH / 16-JUNE-20				
PROCESS APPROVAL	INITIAL / DATE					
MECHANICAL ENGINEER	INITIAL / DATE					

EXHIBIT J

LINDEN SLUDGE PROCESSING PLANT

TOP DOWN SOTA ANALYSIS - SOX

Linden Sludge Processing Plant

Top Down SOTA Analysis Technical Note SOx Emissions Control

CONFIDENTIAL

May 20th, 2019

Revision 4

Rev	Date	Description	Prepared	Checked	Approved
0	04/15/2019	Issued for Review	J. Thornton	B. Davis	R. Kelfkens
1	04/18/2019	Issued for Use	J. Thornton	B. Davis	R. Kelfkens
2	05/08/2019	Section 3.4.3 Updated	J. Thornton	B. Davis	R. Kelfkens
3	05/13/2019	Cost Effectiveness Re-evaluated	J. Thornton	B. Davis	R. Kelfkens
4	05/20/2019	Cost Effectiveness Re-evaluated	J. Thornton	B. Davis	R. Kelfkens

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Technical Note

1. Introduction

Aries Clean Energy (Aries) has completed a "Top Down" State of the Art (SOTA) Analysis for the SOx control technologies to determine which of the technologies should be used at the Linden Sludge Processing Plant. This technical note has been prepared in accordance with N.J.A.C 7:27-8.12(f)1-3 to satisfy the requirement of a SOTA analysis to be performed for any contaminant above the SOTA thresholds as per Appendix 1 in N.J.A.C. 7:27-8.

The Air Pollution Control Act (N.J.A.C. 7:27-8 and N.J.A.C. 7:27-22.35) states that newly constructed, reconstructed, or modified equipment and control apparatus is required to incorporate advances in the art of air pollution control. "Advances in the art of air pollution control" is commonly referred to as "State of the Art" or SOTA. SOTA generally includes performance limits that are based on air pollution control technology, pollution prevention methods, and process modifications or substitutions that will provide the greatest emission reductions that are technologically and economically feasible.

The New Jersey Department of Environmental Protection requires the use of a top down approach to determining SOTA. The top down analysis includes examining the most stringent control technology that is available and achievable while being technically, environmentally, and economically feasible. SOx control technologies are well known and well defined in industry and so the technologies were easily able to be analyzed.

In performing the analysis, Aries was also required to consider specific additional design criteria for the selection of the technology as follows:

- The plant will be housed in an existing redundant dewatering plant building.
- The equipment must fit into the limited physical space and land made available for the project.

2. Summary of Top Down SOTA Analysis Procedure

This analysis follows guidance for the preparation of a top-down analysis. The focus of this analysis was to determine which SOx removal technologies are available that could be reasonably achieved in the Linden Sludge Processing Plant. There are 5 basic steps in a top down analysis procedure, a brief description of each step follows.

Step 1 – Identify all Control Technologies
The first step will identify all available control technologies or techniques with a potential to be applied to the source. From N.J.A.C. 7:27-8-12(f)1:

> *"Identify and evaluate a list of air pollution control technologies or measures that may be applied to the source. This list shall not be limited to measures that have been applied to other existing sources in this same source category. The list shall include measures applied to sources in similar source categories, as well as innovative control technologies, modification of the process or process equipment, other pollution prevention measures, and combinations of the above measures."*

Step 2 – Eliminate Infeasible Control Options
A demonstration of infeasibility of a specific control technology based on physical, chemical, or engineering principles should show that difficulty implementing the technology would preclude it from successfully being implemented as a control option for the process. From N.J.A.C. 7:27-8-12(f)2i-iv explaining how to rank technologies:

i. *"A demonstration that the top measure should be eliminated from consideration because it is technically infeasible, based on physical, chemical, or engineering principles, and/or technical difficulties that would prevent the successful application of the measure;*
ii. *A demonstration that the top measure should be eliminated from consideration based on its environmental impacts. The justification shall show that the adverse environmental effects of the top measure (for example, effects on water or land, HAP emissions, or increased environmental hazards), when compared with its air contaminant emission reduction benefits, would make use of the top measure unreasonable;*
iii. *A demonstration that the top measure should be eliminated from consideration based on its economic impacts. The justification shall show that the total and incremental costs of the top measure are greater than the total and incremental costs of the proposed measure(s); and that the extra costs, when compared with the air contaminant emission reduction benefits resulting from the top measure, would make use of the top measure unreasonable. All costs shall be calculated using the techniques in the latest edition of EPA's control cost manual; or*

iv. *A demonstration that the top measure should be eliminated from consideration based on its energy impacts. The justification shall show that the top measure uses fuels that are not reliably available; or that the energy consumed by the top measure is greater than the proposed measure(s), and that the extra energy used, when compared with the air contaminant emission reduction benefits resulting from the top measure, would make use of the top measure unreasonable."*

Step 3 – Rank Remaining Control Technologies by Control Effectiveness
Rank the remaining control technologies that have not been ruled out based primarily on control efficiency but also on environmental impacts, energy impacts and economic impact.

Step 4 – Evaluate the Most Effective Controls and Document Results
Evaluate each option and if the top option is not selected as SOTA then evaluate the next most effective control technology.

Step 5 – Select SOTA
The most effective technology that has not been rejected will be considered SOTA.

3. SOTA Analysis

3.1. Identify Control Technologies

SOx typically enters the air through the processing of fuels that contain a substantial Sulfur content (> 0.5%) and represents a large source of air pollution. SOx and specifically SO_2 is a chemical that can present a health hazard to humans as a corrosive irritant to the eyes and skin and can be lethal at high doses. As such, extensive research has been put into improving technologies to remove SOx from flue gases. These removal technologies are well known in the industry and are summarized in Table 3.1

Table 3.1 – SOx Removal Technologies

Technology	Raw Materials Required	Byproducts	Maximum Fuel Sulfur Content	Maximum SO_2 Removal Efficiency
Wet Scrubbers	Limestone, Lime, Water, Seawater	Gypsum, Sludge, Wastewater, Waste Seawater	3.5%	90-98%
Spray Dry Scrubbers	Lime, Calcium Oxide, Water	Calcium Sulfate, Sulfite and Fly ash	3.5%	90-95%
Dry Sorbent Injection	Hydrated Lime	Calcium Sulfate, Sulfite and Fly ash	3.5%	90-98%
Wet Sulfuric Acid Process	Natural Gas, Cooling Water, Catalyst	Steam, Sulfuric Acid, Spent Acid	3-6%	70-95%
Dry Scrubbing	Limestone, Lime, Dolomite	Calcium Sulfate, Sulfite and Fly ash	1%	50%

3.2. Eliminate Technically Infeasible Options

The choice of the appropriate SOTA sulfur removal technology is influenced by the sulfur levels in the fuel. In general, fuel in refineries or coal plants contain sulfur levels in the typical range of 3-6%. Biosolids fuel in the Aries gasification unit is typically around 1.65% Sulfur. The lower concentration limited the choice of feasible sulfur removal technology that could be considered from the available technologies listed in Table 3.1.

3.2.1. Wet Scrubbers

Wet Scrubbing systems remove SOx from flue gas by providing intimate contact between the gas and a slurry of finely ground limestone or lime. The slurry is injected into a vessel designed for SOx removal and absorbs the SOx from the flue gas to form a mixture of calcium sulfite and calcium sulfate (gypsum). The process efficiency is generally stated to be up to 98% for medium to high sulfur fuels. There are also wet scrubbing systems that use seawater instead of lime or limestone due to it's high alkalinity.

3.2.1.1 Technical Feasibility Analysis

For wet scrubbers, the inlet gas temperature requirement ranges between 300-700°F. To be technically feasible, this would mean the wet scrubber would need to be installed in the Aries system downstream of the first heat recovery exchanger. However, due to the nature of the wet scrubbing process and the interaction of the flue gas with the injected lime, limestone or seawater a temperature drop of 200-400°F will result across the system. This temperature drop is due to the requirement for the flue gas temperature to be slightly above the adiabatic saturation temperature to avoid wet solids deposit on downstream equipment.

The application of a wet scrubber is **not a technically feasible option** in Aries's system for two reasons; 1) The temperature drop in the scrubber would result in a loss of recoverable heat in the flue gas which is required for the dryer to dry the incoming biosolids, and; 2) The temperature drop would reduce the flue gas temperature outside the optimal operating range for the NOx removal system and achieving 95% NOx removal would not be possible.

3.2.1.2 Environmental Impacts

The major environmental impact of wet scrubbing is the generation of waste water from the scrubbing process. The waste water resulting from lime or limestone use is a highly scaling water that requires specialty treatment on site. There will also be some blowdown of evaporated water out of the stack which will also add an estimated 50-100 gpm of steam emissions to the stack. If seawater is used as the scrubbing medium the seawater will also require additional treatment before being discharged and this water can have an adverse effect on the surrounding marine environment. This is because most plankton that is in the intake is killed and breaking down the plankton will require oxygen increasing the biochemical oxygen demand and therefore reducing the quality of the local marine environment at the discharge point. Seawater is not readily available on site and so would not be available for consideration.

3.2.1.3 Economic and Energy Impact

The cost of wet scrubbing systems can vary from $500-5,000/ton of SOx removed depending on removal efficiency required. $500/ton is for low removal (<75%) and $5000/ton is for high removal (>95%). This is due to the high liquid to gas ratio required as the SOx removal efficiency increases which results in more slurry material being required. Limestone is the cheapest slurry but is typically limited to 90% removal whereas lime systems can achieve higher efficiencies (up to 98%). Increasing the efficiency from 95% to 98% becomes extremely cost intensive as lime is roughly 4 times more expensive than limestone.

The loss in heat described in Section 3.2.1.1 could potentially be restored by adding an additional natural gas auxiliary heater to the system to re-heat the flue gas. However, this would incur additional investment cost for installed equipment (approximately $300,000 based on a quote for a similar sized unit) and additional natural gas usage. The additional natural gas usage equivalent to an estimated additional 12.4 MMBTU/hr or 13,974 scfh. Assuming $4.30 per MMBTU delivered this equates to approximately $1,280/day or an additional $504/ton of SOx removed at 98% removal. This additional cost is not economically feasible and increases fossil fuel use.

A wet scrubber system also has a large capital cost associated with it and is generally economically viable when treating medium to high Sulfur content fuels in the range of 2-3.5%. The fuel being used in the Linden project is low in Sulfur content (around 1.65%) and so is below the typical economic viability range for using a wet scrubber. In the wet scrubbing process, there is also the requirement to generate steam and drive the reactions, this would also take away from the energy required by Aries to dry the biosolids. There is also a large energy demand associated with preparing the lime or limestone via milling to create the slurry. Typically, this is done onsite to make storage of the sorbent easier and cheaper however it is very energy intensive and there is not enough space on the site for milling.

3.2.2. Spray Dry Scrubbers

Spray dry scrubbers are the next most widely used technology for SOx removal after wet scrubbing. The spray dry scrubbing process (also known as semi dry scrubbing) has some similarities to the wet scrubbing process. In this case however lime must be used because limestone is not suitable for this process. The lime is mixed with water to form a suspension and the suspension is injected into the absorber as a fine mist. The high surface area of the droplets reacts with the incoming flue gas to remove the SOx using flue gas distribution mechanisms to aid removal.

3.2.2.1 Technical Feasibility Analysis

Similar to the wet scrubbing system, the spray dry scrubber requires a specific inlet flue gas temperature in order to operate effectively. The relative humidity in the unit is required to be held at a specific point (~6%) which requires the temperature of the inlet flue gas to be controlled at approximately 250-300°F. This is too low for the Aries process as the flue gas that would enter the scrubber is at a minimum ~500°F. Dry scrubbing is **not technically feasible** at these temperatures because the relative humidity required in the unit will not be able to be maintained at these temperatures which will result in a decrease in SOx removal efficiency below the typical range of 90%-95%.

3.2.2.2 Environmental Impacts

The dry spray scrubbing process does not produce any waste water because all water in the process is completely evaporated in the absorber. The main byproduct of this process is calcium sulfate and calcium sulfite as a dry particulate. Some of this particulate remains in the absorber but the majority is entrained in the flue gas so therefore the particulate emissions will increase. Typically, an electrostatic precipitator or a fabric bag house is installed to remove the particulate which requires additional capital and operating cost to remove the particulate. The calcium sulfate and sulfite byproduct may have an industrial application depending on its properties but will likely need to be landfilled.

3.2.2.3 Economic Impact

Spray Dry scrubbing technology is extremely cost intensive due to the requirement to use lime in the absorber. Cost of removing 90% to 95% is between $500-$4000/ton. Like wet scrubbing $500/ton is for low removal (<75%) and $4000/ton is for high removal (>95%).

3.2.3. Wet Sulfuric Acid (WSA) Process

Flue gas is cleaned in an electrostatic precipitator and heated by feed/effluent heat exchange with the gas leaving the SO_2 converter in a regenerative or recuperative heat exchanger. After the heat exchange, the gas is introduced to the SO_2 converter which turns SO_2 into SO_3. The converted gas is then introduced to the effluent heat exchanger, and final cooling and condensation takes place in the WSA condenser where it is converted to sulfuric acid in the presence of water. The cleaned gas is sent directly to the stack, and the heated cooling air is returned to the boiler.

3.2.3.1 Technical Feasibility Analysis

Unlike other technologies analyzed there is no unwanted byproduct of the WSA process. The main by-product of this process is sulfuric acid which has some value. Sulfuric acid is a highly corrosive liquid that requires special handling systems and procedures. The WSA is typically used on higher sulfur content fuels in the order of 3-6% sulfur. This range is due to the requirement to keep the dew point of sulfuric acid between a certain range. If the sulfur content of the feed is too low or too high the conversion to sulfuric acid is reduced and therefore the removal efficiency is decreased. The Aries fuel is expected to have a maximum of 1.65% Sulfur in the feed and therefore is **not technically feasible** for this process.

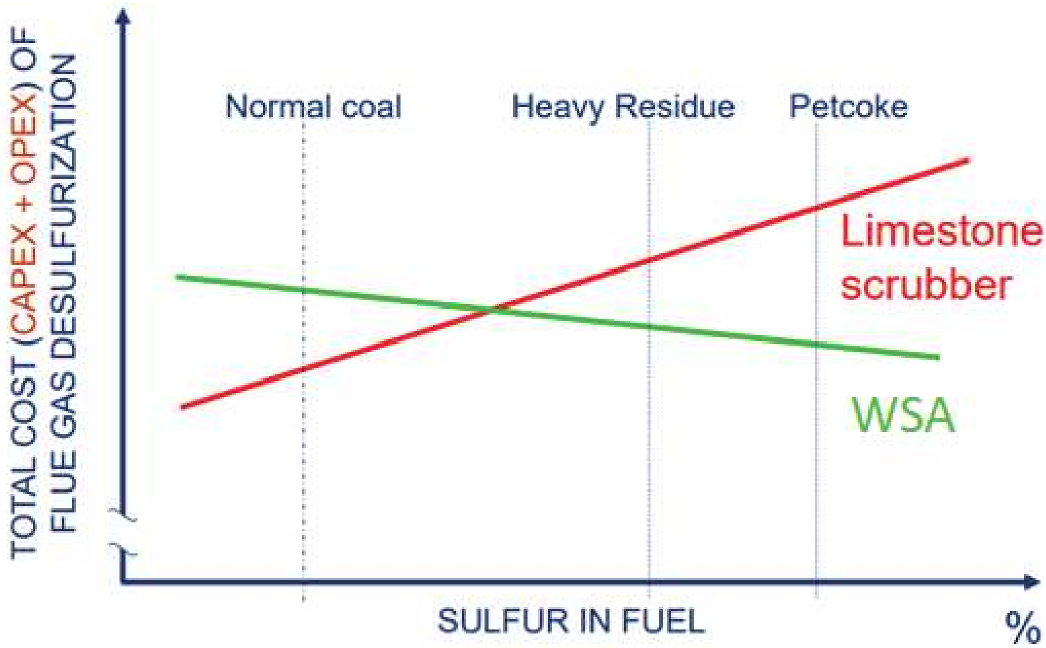
3.2.3.2 Environmental Impacts

The WSA process produces no wastewater or other by-products however sulfuric acid is one of the main by-products which is a highly corrosive material and will exist as particles when released to the atmosphere therefore extreme care in handling the acid must be taken. Sulfuric acid dissolves in water and is toxic to marine life and flora and fauna.

3.2.3.3 Economic Impact

The WSA process requires a significant amount of equipment so it is capital intensive, however, the operating costs are low when taking into account the ability to sell the sulfuric acid by-product. The fact that the Aries fuel is outside the optimum fuel sulfur range means not only decreased efficiency but also means there will not be as much sulfuric acid generated therefore adversely affecting operating cost. While specific operating cost information could not be obtained, WSA cost is more expensive using low sulfur content fuel and gets more economically viable as sulfur content increases. Figure 3.1 shows a chart supplied by a WSA vendor that shows the cost compared to limestone scrubbing. Aries fuel sulfur content is lower than normal coal and so the operating cost is higher than that of wet scrubbing.

Figure 3.1 – Total Cost of WSA vs Wet Limestone Scrubbing



3.3. Rank Remaining Control Technologies by Control Effectiveness

Table 3.2 summarizes the findings of the top-down analysis and ranks them in order of effectiveness.

Table 3.2 – Ranking Removal Technologies

Technology	Removal Efficiency	Technically Feasible?	Environmental Impact	Economic Impact	Energy Impact	Ranking
Dry Sorbent Injection	90-98%	Yes	None, byproduct qualifies for beneficial use.	Low Capex, Medium Opex	Medium	1
Dry Scrubbers	50%	Yes	Spent Sorbent with potential beneficial use application.	Low Capex, Low Opex	Low	2
Wet Scrubbers	90-98%	No	Wastewater Required for treatment.	High Capex, Med to High Opex	High	N/A
Spray Dry Scrubbers	90-95%	No	Increases landfill	High Capex, Medium Opex	High	N/A
Wet Sulfuric Acid Process	70-95%	No	None if safely handled	High Capex, Low Opex	High	N/A

3.4. Evaluate the Most Effective Controls and Document Results

The most effective control technology based on the rankings in Section 3.3 is Dry Sorbent Injection (DSI). Dry scrubbing was also found to be feasible, however, the extremely low removal efficiency ruled this option out immediately and no further investigation has been done. DSI typically employs hydrated lime as a sorbent material and is injected into the flue gas where it interacts with the sulfur compounds in the gas to form a solid calcium sulfate and gaseous water. The solids particles are then captured on filters and removed. DSI systems typically have removal efficiencies between 90 and 98%. The evaluation of this technology includes whether the stated removal efficiencies have been achieved in practice, technology availability, the cost effectiveness of these efficiencies and the environmental impact.

3.4.1. Achieved in Practice Evaluation

The DSI system that Aries proposes for this project has an installed base of DSI systems for removing SOx of approximately 20 units mainly on glass plants in various locations around the USA with one unit located in New Jersey that is approximately 20% larger than the Aries system. The systems vary in removal efficiency depending on the project and type of installation. Some of these plants achieve 95% removal efficiency and therefore Aries's assessment is that 95% removal of SOx has been demonstrated as both technically feasible and achieved in practice. Aries does not have or could not obtain any specific supporting data to show that 98% has been achieved in practice but it is considered technically feasible.

3.4.2. Commercial Availability Evaluation

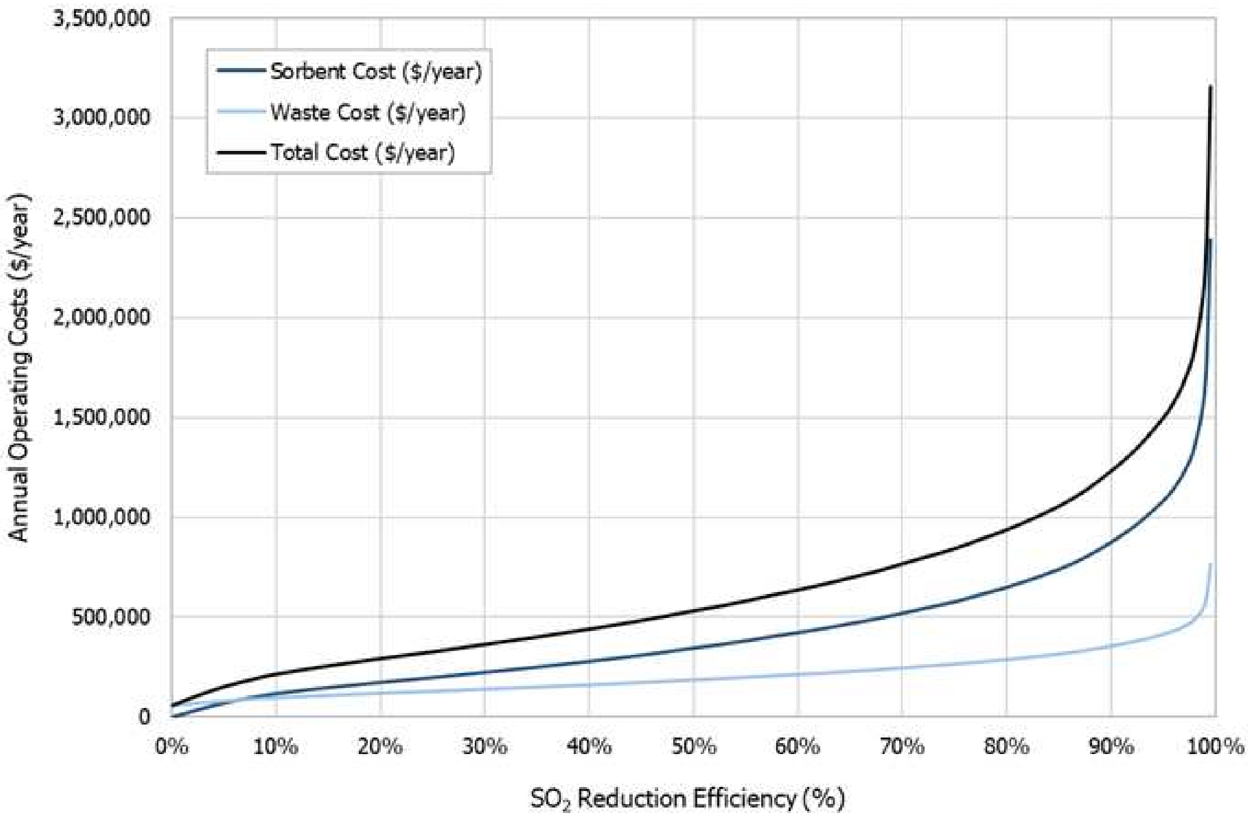
As part of the technical review process, Aries has been in contact with suppliers of DSI technology. To be considered commercially available there must be at least one equipment vendor that will offer the equipment for full scale operation in the United States, have a track record of commercial units in operation and offer performance guarantees for the technology. Aries received official proposals from two equipment vendors that met these criteria and had communications with one other vendor. Aries's conclusion is that the technology is commercially available.

3.4.3. Cost Effectiveness Evaluation

The selected DSI system technology as proposed and guaranteed by the vendor achieves an optimal SOx removal efficiency of 90%. The system to be installed is capable of meeting higher removal efficiencies. Increasing the removal efficiency from 90% to 98% would result in an increase to the overall removal of approximately 850 tons/year to 926 tons/year or an extra 76 tons/year of SOx removal. As a DSI system's removal efficiency increases, the amount of sorbent required to achieve that level of removal increases exponentially along with a commensurate exponential increase in operating cost. Figure 3.2 shows the relationship between removal efficiency and sorbent requirements.

Technical Note

Figure 3.2 – Operating Cost vs Removal Efficiency for DSI



The amortized cost effectiveness at 90%, 93%, 95%, 96%, 97% and 98% has been calculated using the EPA Cost Control Manual and has been supplied to NJDEP. The cost per ton removed has been summarized in Table 3.3.

Table 3.3 – Cost Effectiveness vs Removal Efficiency

SOx Removal Efficiency	Cost Per Ton Removed
90%	$2,465 / ton
93%	$2,838 / ton
95%	$3,264 / ton
96%	$4,377 / ton
97%	$5,037 / ton
98%	$5,318 / ton

Aries could not locate published cost effectiveness thresholds for pollutant control by the State of New Jersey but did find thresholds published by San Joaquin Valley Air Pollution Control District (SJVAPCD) and these have been summarized in Table 3.4.

Table 3.4 – SJVAPCD Cost Effectiveness Thresholds

Pollutant	Cost Effectiveness ($/ton) (2008 dollars)	Cost Effectiveness ($/ton) (2019 dollars)
SOx	3,900	4,721

In determining if a technologically feasible control technique is cost effective, the cost was compared to the cost effectiveness thresholds for a given pollutant. For example, the cost effectiveness for 90% removal is $2,465/ton, and therefore is determined to be cost effective because its cost effectiveness is less than the SJVAPCD's 2019 cost effectiveness threshold ($4,721/ton). The cost effectiveness for 98% removal is $5,318/ton, and therefore should be determined not to be cost effective because its cost effectiveness is greater than the SJVAPCD's cost effectiveness threshold ($4,721/ton).

Aries has evaluated four different levels of removal and found that 90-96% removal are all below the cost-effectiveness thresholds used by SJVAPCD. Aries has determined that 96% removal efficiency is achievable technically. 96% removal will put a significant strain financially on the Aries Linden project, however Aries is committed to reducing the environmental footprint from the project and doing whatever is possible to make this happen. At 96% efficiency the total yearly emissions of SOx have been calculated to be 38.1 tons/year which brings it well below 50% of the level that would create a major source facility and as a result of this Aries believes the highest possible cost-effective removal efficiency for SOx is 96%.

Table 3.4 summarizes operating costs of all evaluated technologies.

Table 3.4 – Operating Costs of Various Technologies

Technology	Removal Efficiency	Cost per ton SOx removed at 90%	Cost per ton SOx removed at maximum removal efficiency
Dry Sorbent Injection	90-98%	$2,465	$5,318
Wet Scrubbers	90-98%	~$2,500 Note 2	$5,000 Ref. 8
Spray Dry Scrubbers	90-95%	~$2,000 Note 2	$4,000 Ref. 8
Wet Sulfuric Acid Process	70-95%	Unknown Note 1	Unknown Note 1

Note 1: While the exact operating cost is unknown from information from an equipment vendor shown in Figure 3.1 it was determined to be higher than wet scrubbing.
Note 2: The cost per ton at 90% was calculated based on applying an exponential function for the removal efficiency range for that specific technology to estimate the cost per ton at 90%.

3.4.4. Environmental Impact Evaluation

As mentioned the increase in removal efficiency from 90% to 98% exponentially increases the sorbent usage. The increase in sorbent use equates to approximately 6,000 tons/year or a 200% increase. A by-product of the DSI process is calcium sulfate in solid form (spent sorbent) and unreacted sorbent. Aries intends to take this by-product and recycle as much as possible back into the system to get maximum usage out of the sorbent material. Aries intends to work with the equipment vendor to enter into an offtake agreement for beneficial use of the by-product. The increase in by-product may potentially require that the excess spent sorbent be sent to a landfill increasing the load to local area landfills.

3.5. Select SOTA

Based on the analysis performed in Section 3.3 and 3.4 the DSI technology is considered SOTA for this facility. It has been determined that 98% removal efficiency using this technology is technically feasible however the cost effectiveness of this increase needs to be taken into consideration. The NJDEP does not seem to have published hard guidance on what defines cost effective, however, the increase from 90% to 98% removal efficiency results in 200% increase in operating cost per ton removed. This is well in excess of what should be considered a reasonable increase. 96% removal efficiency will bring the total SOx emissions to 38.1 tons/year and represents an efficiency that is both technically and economically feasible. DSI will also allow Aries to use a state of the art integrated emissions control unit that combines SOx, NOx and PM control into one unit which alleviates space constraints for this project and guarantees the removal of all contaminants. For the reasons described throughout this report, Aries concludes that Dry Sorbent Injection at 96% removal efficiency is considered SOTA for SOx removal at the Linden Sludge Processing Plant.

4. References

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Newark Sludge Processing Plant

400 Doremus Ave Newark, NJ

OS0	**Summary**			
	Mass Flow	Control Device Efficiency	Controlled Emissions	Threshold
	ton/y		ton/y	ton/y
VOC	1,768.9	0.9950	8.96	25
CO	12,378.4	0.9999	12.38	100
PM2.5	885.3	0.99	13.02	100
PM10	885.3	0.99	13.02	100
TSP	885.3	5.18	13.02	100
SOx	1,137.4	0.96	45.50	100
NOx	374.5	0.95	18.72	25
NH3	0.238	-	0.238	
HAPs	See Exhibit G			

OS1	**Sludge Unloading to Receiving Hopper 1**				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.037	0.06	-	0.03684	0.05782
CO	0.0	0.0	N/A	0.00	0.00
PM2.5	0.0	0.0	N/A	0.00	0.00
PM10	0.0	0.0	N/A	0.00	0.00
TSP	0.0	0.0	N/A	0.00	0.00
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
NH3	0.076	0.119	-	0.076	0.119
HAPs	See Exhibit G				

OS2	**Sludge Unloading to Receiving Hopper 2**				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.04	0.06	-	0.03684	0.05782
CO	0.0	0.0	N/A	0.00	0.00
PM2.5	0.0	0.0	N/A	0.00	0.00
PM10	0.0	0.0	N/A	0.00	0.00
TSP	0.0	0.0	N/A	0.00	0.00
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
NH3	0.076	0.119	-	0.076	0.119
HAPs	See Exhibit G				

OS3	Vented Gas from Sludge Storage Bin 1				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.06	0.24	0.9950	0.00028	0.00122
CO	0.0	0.0	N/A	0.00	0.00
PM2.5	0.0	0.0	N/A	0.00	0.00
PM10	0.0	0.0	N/A	0.00	0.00
TSP	0.0	0.0	N/A	0.00	0.00
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
NH3	0.114	0.502	0.9000	0.011	0.050
HAPs	See Exhibit G				

OS4	Vented Gas from Sludge Storage Bin 2				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.06	0.24	0.9950	0.00028	0.00122
CO	0.0	0.0	N/A	0.00	0.00
PM2.5	0.0	0.0	N/A	0.00	0.00
PM10	0.0	0.0	N/A	0.00	0.00
TSP	0.0	0.0	N/A	0.00	0.00
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
NH3	0.11	0.502	0.9	0.011	0.050
HAPs	See Exhibit G				

OS5	Particulate Emissions from Gasifier Feed Bin 1				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.0	0.0	N/A	0.00	0.000
CO	0.0	0.0	N/A	0.00	0.000
PM2.5	1.8	7.8	0.99	0.02	0.078
PM10	1.8	7.8	0.99	0.02	0.078
TSP	1.8	7.8	0.99	0.02	0.078
SOx	0.0	0.0	N/A	0.00	0.000
NOx	0.0	0.0	N/A	0.00	0.000
HAPs	See Exhibit G				

OS6	Particulate Emissions from Gasifier Feed Bin 2				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y

VOC	0.0	0.0	N/A	0.00	0.00
CO	0.0	0.0	N/A	0.00	0.00
PM2.5	1.8	7.8	0.99	0.02	0.08
PM10	1.8	7.8	0.99	0.02	0.08
TSP	1.8	7.8	0.99	0.02	0.08
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
HAPs	See Exhibit G				

OS7	**Gasifier Normal Operations**				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	428.2	1,766.3	0.995	2.14	8.83
CO	2,993.4	12,347.7	0.999	2.99	12.35
PM2.5	194.2	801.1	0.99	1.94	8.01
PM10	194.2	801.1	0.99	1.94	8.01
TSP	194.2	801.1	0.99	1.94	8.01
SOx	275.7	1,137.2	0.96	11.03	45.49
NOx	89.8	370.4	0.95	4.49	18.52
HAPs	See Exhibit G				

Notes:

1. VOC, CO, PM10 and TSP numbers come from the Newark Heat and Material Balance.

OS8	**Maintenance Operations - Gasifier Down**				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y
VOC	0.5	2.0	0.995	0.003	0.010
CO	8.2	30.7	0.999	0.008	0.0307
PM2.5	0.7	2.8	0.99	0.01	0.0277
PM10	0.7	2.8	0.99	0.01	0.0277
TSP	0.7	2.8	0.99	0.01	0.0277
SOx	0.06	0.22	0.96	0.002	0.009
NOx	1.1	4.1	0.95	0.06	0.205
HAPs	See Exhibit G				

References:

1 - Emission estimates are calculated from mass flow rates from the HMB for each operating scenario.

2 - Natural Gas Emission estimates based on AP-42, Chapter 1.4, Tables 1.4-1 and 1.4-2 (updated 07/98).

OS9	**Particulate Emissions Charging Biosolids Loadout Bin**				
	Mass Flow		Control Device Efficiency	Controlled Emissions	
	lb/hr	ton/y		lb/hr	ton/y

VOC	0.0	0.0	N/A	0.00	0.00
CO	0.0	0.0	N/A	0.00	0.00
PM2.5	0.6	2.3	0.99	0.01	0.02
PM10	0.6	2.3	0.99	0.01	0.02
TSP	0.6	2.3	0.99	0.01	0.02
SOx	0.0	0.0	N/A	0.00	0.00
NOx	0.0	0.0	N/A	0.00	0.00
HAPs	See Exhibit G				

E1 and E2 Emissions Calculation

The US EPA1 provides the method for calculating emissions from wastewater treatment sludge as E = EF x Q x C x T where:

E is the mass emission rate for the volatile organic compound species in grams/day
EF is the emissions factor of the species in grams/ m3
Q is the volumetric flow rate in m3 per day
C is equal to 1 - f where f is the emissions control efficiency
While the sludge receiving bins are open to atmosphere the emissions control efficiency (f) is 0
T is the percentage time the bins would be open, and the emissions control efficiency is 0

Maximum time to unload a truck is 30 minutes if the truck is completely full with 25 tons

T_{max} = Time to Unload (.5 hours) x Daily Unloading Amount (430 t/d) / Capacity of Truck (25 tons/truck)

T_{max} = 8.6 hours /day

T_{max} = 36%

	Sludge Received tons/day	Operating Days/year	EF g/m^3	Q m^3/day	C	T_{max}	E g/d	Uncontrolled Emissions t/y
Ammonia	430	365	2.2	374.8	1	36%	107,848.3	**0.119**
VOC's	430	365	1.07	374.8	1	36%	52,453.5	**0.058**

Standard Conversions

Sludge Density is 65 lbs/ft^3 9.370233 157.8364

1 m^3 = 35.3 ft

1 year = 365 days

1 ton = 907,185 grams

E3 and E4 Emissions Calculation

The US EPA1 provides the method for calculating emissions from wastewater treatment sludge as E = EF x Q x C x T where:

E is the mass emission rate for the volatile organic compound species in grams/day
EF is the emissions factor of the species in grams/ m3
Q is the volumetric flow rate in m3 per day
C is equal to 1 - f where f is the emissions control efficiency
Until the storage bins enter emissions control equipment the emissions control efficiency (f) is 0
T is the percentage time the bins will contain sludge, and the emissions control efficiency is 0

T_{max} = 24 hours /day
T_{max} = 100%

	Storage Capacity tons	Operating Days/year	EF g/m^3	Q m^3/day	C	T_{max}	E g/d	Uncontrolled Emissions t/y
Ammonia	650	365	2.2	566.6	1	100%	454,957.5	**0.502**
VOC's	650	365	1.07	566.6	1	100%	221,274.8	**0.244**

Standard Conversions
Sludge Density is 65 lbs/ft^3
1 m^3 = 35.3 ft 14.16431 0.789182
1 year = 365 days
1 ton = 907,185 grams

DEP Pre Construction Permit ID No (PCP #)

E5 and E6 Particulate Matter Emissions Calculation

Dried Biosolids	Hours/Year	Days/Year	Solids Loaded tons/day	Total Fines	Fines as Dust	Uncontrolled PM10 Emissions ton/year
PM10 Emissions OS5 - Gasifier Feed	8760	365.0	42.5	5%	1%	**7.8**
PM10 Emissions OS6 - Gasifier Feed	8760	365.0	42.5	5%	1%	**7.8**
PM2.5 Emissions OS5 - Gasifier Feed	8760	365.0	42.5	5%	1%	**7.8**
PM2.5 Emissions OS6 - Gasifier Feed	8760	365.0	42.5	5%	1%	**7.8**

Notes:

1. OS9 are dust emissions while the bin is loading. This occurs anytime and therefore theoretically operates 8,760 hours per year.
2. When loading the bin assumed dust settles within the bin so fines as dust are 1%.
3. All PM Emissions are assumed to be PM 2.5 and greater

ARIES CLEAN ENERGY™

DEP Program Interest No. (PI #)
DEP Pre Construction Permit ID No (PCP #)

Emissions Calculation

Operating Scenario	Normal Operations, Steady State, With Gasifier
NJID	OS7

Gas flow at SCR outlet, acfm	**T, deg F**	**moisture content mol %**	**Gas flow pressure, psig**	**Gas flow at SCR outlet, scfm**	**Gas flow at SCR outlet (dry), dscfm**
55,123	700	10.6	-1.3	22,993	20,555

Case study

Cases	**NOX inlet emissions, ppmv**	**NOX inlet mass flow, lb/hr**	**NOX outlet emissions, ppmv**	**NOX outlet mass flow, lb/hr**	**NOX outlet mass flow, TPY**
High Emissions	610	89.8	30.50	4.49	18.52

Compound		NOx
mol wt, lb/lbmol		46

Case study

Cases	**Sulphur in feed lb/hr**	**SOX Inlet mass flow lb/hr**	**SOX inlet mass flow TPY**	**SOX outlet mass flow TPY**
Mean Emissions	138.0	275.7	1137.2	45.49

Compound	Sulfur	SOx
mol wt, lb/lbmol	32.065	64.066

Mass Emissions

Mass Emissions (mass per time) are calculated based on measured concentration, molecular weight and volumetric flow:

$$\frac{lb}{hr} = \left[\frac{[conc]ppmV}{1{,}000{,}000}\right] x \frac{MW}{385.4\,ft^3/lb\ mol} x\,VolFlowx60$$

- lb/hr is mass emissions in pounds per hour
- [conc]ppmV is measured concentration, measured in parts per million, volume
- MW is molecular weight in pounds per pound-mole (lb/lb-mol)
- VolFlow is Volumetric flow, measured in dry, standard cubic feet per minute (dscfm)
- 60 signifies 60 minutes per hour
- 385.4 is the number of cubic feet in a pound-mole of gas at standard temperature and pressure

$$\frac{lb}{MMBtu} = \frac{lb/hr}{MMBtu/hr}$$

- lb/MMBtu is mass emissions, measured in pounds per million British Thermal Units
- MMBtu/hr is the heat input to a system, measured in million British Thermal Units per hour

TO CONVERT ACFM TO DSCFM

$$DSCFM = ACFM \times \frac{(460°R + 70)}{(460°R + temp)} \times \frac{\text{actual P}}{14.7} \times (1 - B_{wo})$$

Feed Basis

Sludge feed to facility ("As Received")	430	tons/day
	35,833	lb/hr

Sludge Dryer

	Inputs		
Pressure	0	psi, d	Must be >=0
Heat Loss	-1.20E+06	BTU/hr	
Fraction moisture in solids	0.1		

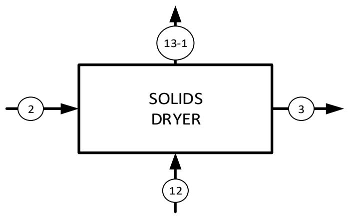
	Results	
Exhaust Gas Temperature	185.1	F
Exhaust Gas Dewpoint	156.0	F
Exhaust Superheat	29.1	F

Drying Gas Out

Mass Flow	188,058	lb/hr
Volume Flow	56,502	ft^3/min
Temperature	185.1	F
Pressure	14.70	psia

Solids In

Mass Flow	35,833	lb/hr
% Moisture	79.00	%
Temperature	80	F
Pressure	14.7	psia



Solids Out

Mass Flow	8,361.1	lb/hr
% Moisture	10	%
Temperature	185.0	F
Pressure	14.7	psia

Drying Gas In

Mass Flow	160,586	lb/hr
Volume Flow	97,109	ft^3/min
Temperature	945.0	F
Pressure	14.7	psia

Solid Split to Biosolids

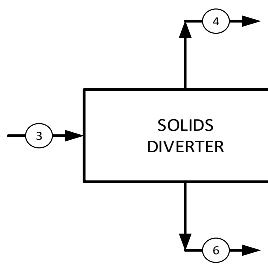
Total Solids from dryer	8,361.1	lb/hr
Solids to Biosolids	0.0	lb/hr
Solids to Gasifier	8,361.1	lb/hr

Solids To Biosolids Screw Cooler

Mass Flow	0	lb/hr
Temperature	185.0	F
Pressure	14.7	psia

Solids from Dryer

Mass Flow	8,361.1	lb/hr
Temperature	185.0	F
Pressure	14.7	psia



Solids To Gasifier

Mass Flow	8,361	lb/hr
Temperature	185.0	F
Pressure	14.7	psia

Biosolids Screw Cooler (SC122056)

	Inputs	
Solids Outlet Temperature	100	F

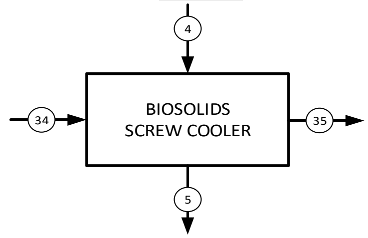
	Results	
Duty	0	BTU/hr

Solids To Biosolids Screw Cooler

Mass Flow	0	lb/hr
Temperature	185.0	F
Pressure	14.7	psia

Cooling Water Supply

Mass Flow	0	lb/hr
Temperature	85	F
Pressure	45	psia



Cooling Water Return

Mass Flow	0	lb/hr
Temperature	98	F
Pressure	45	psia

Solids Leaving Biosolids Screw Cooler

Mass Flow	0	lb/hr
Temperature	100.0	F
Pressure	14.7	psia

Gasifier Feed Screw Cooler (SC132034)

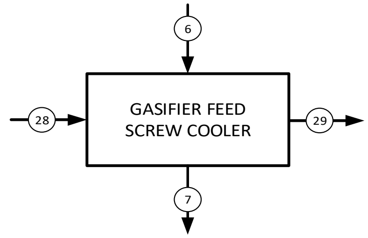
	Inputs	
Solids Outlet Temperature	135	F
	Results	
Duty	190,716	BTU/hr

Solids To Gasifier Screw Cooler

Mass Flow	8,361	lb/hr
Temperature	185.0	F
Pressure	14.7	psia

Cooling Water Supply

Mass Flow	14,723	lb/hr
Temperature	85	F
Pressure	45	psia



Cooling Water Return

Mass Flow	14,723	lb/hr
Temperature	98	F
Pressure	45	psia

Solids Leaving Gasifier Screw Cooler

Mass Flow	8,361	lb/hr
Temperature	135.0	F
Pressure	14.7	psia

Gasifier

Pressure Drop	-0.56	psi
RSTOIC Block		
C+2H2-->CH4 Fract. Conversion	0.1	
0.5N2 + 1.5 H2 -->NH3 Fract. Conversion	0.7	
0.5N2+C+0.5H2-->CHN Fract. Conversion	0.05	
Split Fraction Bypassing RGIBBS Block		
C	12.2%	
CH4	100.0%	
CHN	90.0%	
NH3	90.0%	
Ash	100.0%	
Substream Split Block to Solids Removal (Stream 9)		
Mixed Fraction	0	
CISolid Fraction	0	
NC Fraction	0.9	
Final Separator Block		
C Split Fraction	1	
Ash Split Fraction	0	
Gasifier Outlet Temperature	1250	F

Producer Gas

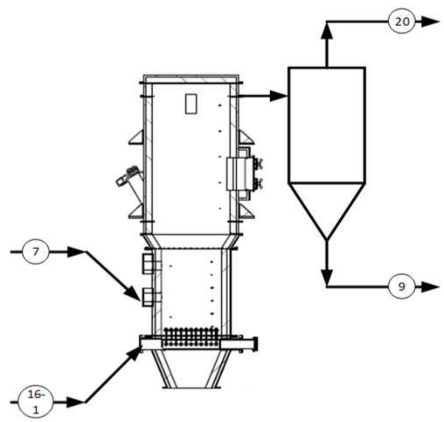
Mass Flow	20,986	lb/hr
Volume Flow	18,662	ft^3/min
Temperature	1250.0	F
Pressure	14.1	psia

Gas Composition, mol%

H2O	0.07770
N2	0.46543
NH3	0.02227
CO	0.12391
CO2	0.10989
CH4	0.03095
CHN	0.00159
COS	0.00014
H2	0.15913
H2S	0.00349
S	0.00000
AR	0.00550

Solids To Gasifier

Mass Flow	8,361	lb/hr
Temperature	135.0	F
Pressure	14.7	psia



Solids From Gasifier

Mass Flow	2,086	lb/hr
Temperature	1250.0	F
Pressure	14.1	psia

Air To Gasifier

Mass Flow	14,904	lb/hr
Volume Flow	2,607	ft^3/min
Temperature	150.3	F
Pressure	21.7	psia

Gasifier Screw Cooler 1 (SC13207)

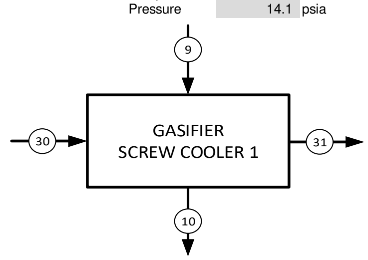
	Inputs	
Solids Outlet Temperature	205	F
	Results	
Duty	570,223	BTU/hr

Solids To Gasifier Screw Cooler 1

Mass Flow	2,086	lb/hr
Temperature	1,250.0	F
Pressure	14.1	psia

Cooling Water Supply

Mass Flow	44,022	lb/hr
Temperature	85	F
Pressure	45	psia



Cooling Water Return

Mass Flow	44,022	lb/hr
Temperature	98	F
Pressure	45	psia

Solids Leaving Gasifier Screw Cooler 1

Mass Flow	2,086	lb/hr
Temperature	205.0	F

Pressure	14.1	psia

Gasifier Screw Cooler 2 (SC17201)

	Inputs	
Solids Outlet Temperature	100	F

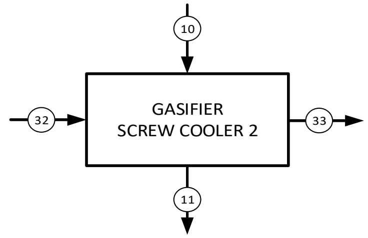
	Results	
Duty	41,718	BTU/hr

Solids to Gasifier Screw Cooler 2

Mass Flow	2,086	lb/hr
Temperature	205	F
Pressure	14.1	psia

Cooling Water Supply

Mass Flow	3,221	lb/hr
Temperature	85	F
Pressure	45	psia



Cooling Water Return

Mass Flow	3,221	lb/hr
Temperature	98	F
Pressure	45	psia

Solids Leaving Gasifier Screw Cooler 2

Mass Flow	2,086	lb/hr
Temperature	100.0	F
Pressure	14.1	psia

Thermal Oxidier Blower (BL-14101)

	Inputs	
Pressure Increase	2.5	psi
Isentropic Efficiency	0.75	(1 = 100%)
Brake Horsepower	203	hp
	151	kW

Inlet Air

Mass Flow	64,711	lb/hr
Volume Flow	14,781	ft^3/min
Temperature	80	F
Pressure	14.7	psia

Outlet air

Mass Flow	64,711	lb/hr
Volume Flow	13,404	ft^3/min
Temperature	113	F
Pressure	17.2	psia

Thermal Oxidizer (TO-14501)

	Inputs	
Pressure	13.78	psia
Heat Duty (Loss)	0	BTU/hr
Thermal Oxidizer Temperature	1800	F

Natural Gas

Mass Flow	0	lb/hr
Temperature	80	F
Pressure	14.696	psia

Producer Gas

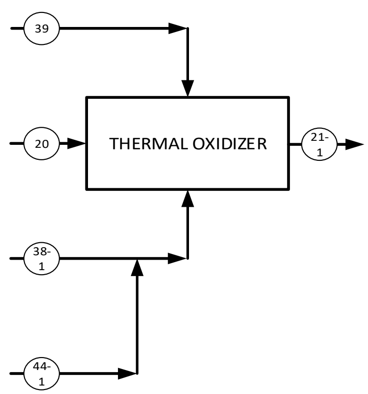
Mass Flow	20,986	lb/hr
Volume Flow	18,662	ft^3/min
Temperature	1,250	F
Pressure	14	psia

TO Blower Outlet Air

Mass Flow	64,711	lb/hr
Volume Flow	13,404	ft^3/min
Temperature	113	F
Pressure	17.2	psia

Dryer Air Loop Purge

Mass Flow	16,109	lb/hr
Volume Flow	3,525	ft^3/min
Temperature	133.8	F
Pressure	17.2	psia



Thermal Oxidizer Exhaust

Mass Flow	101,806	lb/hr
Volume Flow	104,633	ft^3/min
Temperature	1800	F
Pressure	13.7799997	psia

Heat Recovery Exchanger 1 (HX-14502)

	Inputs	
Hot Stream Outlet Temperature	700	F
Hot Side Pressure Drop	-0.36	psi
Cold Side Pressure Drop	-0.36	psi
Constant U value	3	BTU/(hr*ft^2*F)

Results

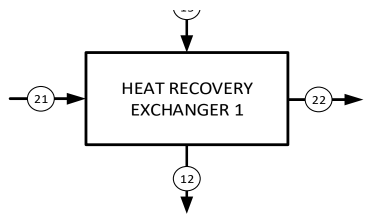
Cold Inlet - Air from HX-14504

Mass Flow	160,586	lb/hr
Volume Flow	41,990	ft^3/min
Temperature	163.1	F
Pressure	15.1	psia

Duty	32,579,942	BTU/hr
LMTD	683.7	F
Area	15,884.5	ft^2

Hot Inlet Gas From TO

Mass Flow	101,812	lb/hr
Volume Flow	104,608	ft^3/min
Temperature	1,800	F
Pressure	13.8	psia



Hot Outlet Gas to the Emission Control Unit

Mass Flow	101,811	lb/hr
Volume Flow	55,123	ft^3/min
Temperature	700	F
Pressure	13.4	psia

Cold Outlet - Air to Dryers

Mass Flow	160,586	lb/hr
Volume Flow	97,108.7	ft^3/min
Temperature	945.0	F
Pressure	14.7	psia

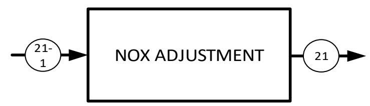
NOX Adjustment

Block removes all NO and converts N2 and O2 NO2 for form a specified amount of NO2. The block is assumed to be isothermal, so the heat duty will be reported.

Temperature	1800	F
Pressure Drop	0	psi
Mole flow of stream 22-1	3566.8	lb mole/hr
NO2 in stream 22-1	0.00671	lb mole/hr
N2 in stream 22-1	2547.36	lb mole/hr
Desired NO2 concentration of NO2 in stream 22	610	ppmv
Moles NO2 desired in stream 22	2.18	lb mole/hr
Moles of NO2 required	2.17	lb mole/hr
Conversion of N2 to NO2 (0.5N2 + O2 --> NO2)	4.26E-04	

Hot Gas From TO

Mass Flow	101,806	lb/hr
Volume Flow	104,633	ft^3/min
Temperature	1,800	F
Pressure	13.8	psia



Hot Gas To Heat Recovery Exchanger 1

Mass Flow	101,812	lb/hr
Volume Flow	104,608	ft^3/min
Temperature	1,800	F
Pressure	13.8	psia

Environmental Control

Temperature	650	F
Pressure Drop	-0.36	psi
Sorbent Flow (SO2 + Ca(OH)2 --> CaSO3 + H2O)		
Moles of SO2	3.13	lb mole/hr
Mass of SO2	200.6	lb/hr
Mass of Ca(OH)2 Fed	540	lb/hr
Fractional conversion of SO2	0.9	
Ammonia Flow (4NH3 + 2NO2 + O2 --> 3N2 + 6 H2O)		
Moles of NO2	2.18	lb mole/hr
Moles of NH3/Mole NO2 (2 moles min)	2	
Moles NH3	4.35	lb mole/hr
Mass NH3	74.0	lb/hr
Mass Ammonia Solution (19 wt% NH3)	389.4	lb/hr
Fractional conversion of NO2	0.95	
Heat Loss	(899,278.9)	BTU/hr

Sorbent

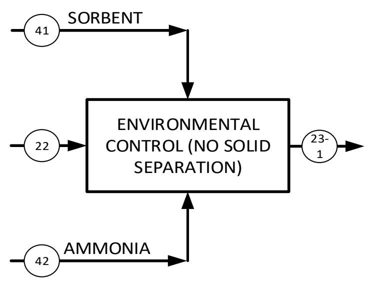
Mass Flow	540	lb/hr
Temperature	80.0	F
Pressure	14.7	psia

Hot Gas from Heat Recover Ex 1

Mass Flow	101,811	lb/hr
Volume Flow	55,123	ft^3/min
Temperature	700.0	F
Pressure	13.4	psia

Ammonia

Mass Flow	389	lb/hr
Temperature	80.0	F
Pressure	14.7	psia



Gas Leaving Evironmental Control

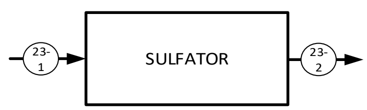
Mass Flow	102,740	lb/hr
Volume Flow	54,605	ft^3/min
Temperature	650.0	F
Pressure	13.1	psia

Sulfator

Temperature	650	F
Pressure Drop	0	psi
Conversion of CaSO3 (2CaSO3 + O2 + 4H2O -->2CaSO4*2H2O)		
Fractional converation of CaSO3	0.9	
Heat Loss	(395,513.8)	BTU/hr

Gas Leaving Evironmental Control

Mass Flow	102,740	lb/hr
Volume Flow	54,605	ft^3/min
Temperature	650.0	F
Pressure	13.1	psia



Gas Leaving Sulfator

Mass Flow	102,740	lb/hr
Volume Flow	54,509	ft^3/min
Temperature	650.0	F
Pressure	13.1	psia

Environmental Control Solids Separation

Fraction of Ca(OH2) removed	1
Fraction of CaSO3 removed	1
Fraction of CaSO4*2H2O removed	1
Fraction of Ash removed	1

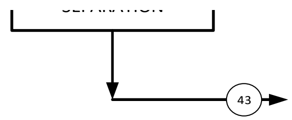
Gas w/ Solids Leaving Sulfator

Mass Flow	102,740	lb/hr
Volume Flow	54,509	ft^3/min
Temperature	650	F

Gas Leaving Evironmental Control

Mass Flow	101,938	lb/hr
Volume Flow	54,466	ft^3/min
Temperature	650.0	F

Pressure	13	psia



Pressure	13.06	psia

Solids Leaving Evironmental Control

Mass Flow	802	lb/hr
Temperature	650.0	F
Pressure	13.06	psia

Heat Recovery Exchanger 2 (HX-14503)
The hot stream outlet temperature is specified
but will be controlled by a design spec.

	Inputs	
Hot Side Pressure Drop	-0.36	psi
Cold Side Pressure Drop	-0.36	psi
Constant U value	3.5	BTU/(hr*ft^2*F)

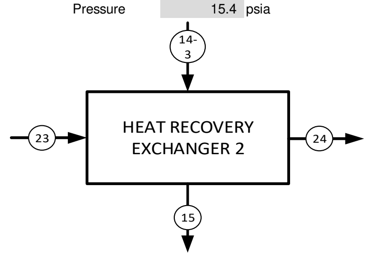
	Results	
Duty	2,115,184	BTU/hr
LMTD	474.6	F
Area	1,273.4	ft^2

Cold Inlet - Recycled Air From Condenser

Mass Flow	160,586	lb/hr
Volume Flow	37,525	ft^3/min
Temperature	110	F
Pressure	15.4	psia

Hot Inlet Gas Environmental Control

Mass Flow	101,938	lb/hr
Volume Flow	54,466	ft^3/min
Temperature	650.0	F
Pressure	13.1	psia



Hot Outlet Gas to the ID Fan

Mass Flow	101,938	lb/hr
Volume Flow	52,110	ft^3/min
Temperature	572.784546	F
Pressure	12.7	psia

Cold Outlet - Air to Heat Recovery Exchanger 1 - HX-14502

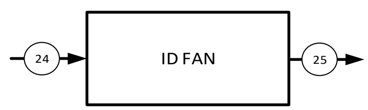
Mass Flow	160,586	lb/hr
Volume Flow	41,990	ft^3/min
Temperature	163.1	F
Pressure	15.1	psia

ID Fan (FN-14102)

	Inputs	
Discharge Pressure	1	psig
Isentropic Efficiency	0.9	(1 = 100%)
Brake Horsepower	699	hp
	521	kW

From Heat Recovery Exchanger 2

Mass Flow	101,938	lb/hr
Volume Flow	52,110	ft^3/min
Temperature	572.8	F
Pressure	12.7	psia



To Stack

Mass Flow	101,938	lb/hr
Volume Flow	44,821	ft^3/min
Temperature	638	F
Pressure	15.7	psia

Gasifier Blower (AC-13102)

	Inputs	
Discharge Pressure	7	psig
Isentropic Efficiency	0.9	(1 = 100%)
Brake Horsepower	100	hp
	75	kW

Ambient Air

Mass Flow	14,904	lb/hr
Volume Flow	3,404	ft^3/min
Temperature	80.0	F
Pressure	14.7	psia

Air to Gasifier

Mass Flow	14,904	lb/hr
Volume Flow	2,607	ft^3/min
Temperature	150	F
Pressure	21.7	psia

Split of Purge Air to Thermal Oxidizer And FN-12104

	Inputs	
Fraction of air purged to thermal oxidizer	0.1	
Discharge Pressure	2.5	psig
Isentropic Efficiency	0.74	(1 = 100%)
Brake Horsepower	38	hp
	28	kW

Purge Flow From Dryer Loop

Mass Flow	16,111	lb/hr
Volume Flow	3,770	ft^3/min
Temperature	110.0	F
Pressure	15.4	psia

Air to Thermal Oxidizer

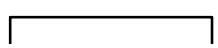
Mass Flow	16,111	lb/hr
Volume Flow	3,525	ft^3/min
Temperature	134	F
Pressure	17.2	psia

Dryer Gas Makeup Flowrate and BL-14103

	Inputs	
Makeup Flowrate	15,585	lb/hr
Discharge Pressure	2	psig
Isentropic Efficiency	0.74	(1 = 100%)

Ambient Air

Mass Flow	15,585	lb/hr



Makeup Air To Dryer Loop

Mass Flow	15,585	lb/hr

Brake Horsepower	50	hp
	37	kW

Volume Flow	3,560	ft^3/min
Temperature	80.0	F
Pressure	14.7	psia
	14.696	

Volume Flow	3,231	ft^3/min
Temperature	113.4	F
Pressure	17.2	psia

Air Temperature Entering Dryer

Design spec "DryTemp" set point	945	

Drying Air Blower (BL-12101)

	Inputs	
Discharge Pressure	1.1	psig
Isentropic Efficiency	0.75	(1 = 100%)
Brake Horsepower	352	hp
	263	kW

Air From Dryer

Mass Flow	188,058	lb/hr
Volume Flow	56,502	ft^3/min
Temperature	185.1	F
Pressure	14.7	psia

Air to Condenser

Mass Flow	188,058	lb/hr
Volume Flow	53,963	ft^3/min
Temperature	202.2	F
Pressure	15.8	psia

Dryer Loop Condenser (HX125012)

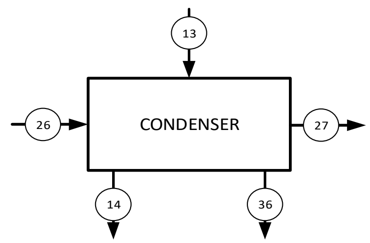
	Inputs	
Hot Stream Outlet Temperature	110	F
Hot Side Pressure Drop	-0.36	psi
	Results	
Duty	33,768,920	BTU/hr
LMTD	42.0	F
Area	5,365.3	ft^2

Air from Drying Air Blower

Mass Flow	188,058	lb/hr
Volume Flow	53,963	ft^3/min
Temperature	202	F
Pressure	15.8	psia

Cooling Water Supply

Mass Flow	2,606,987	lb/hr
Temperature	85	F
Pressure	45	psia



Cooling Water Return

Mass Flow	2,606,987	lb/hr
Temperature	98	F
Pressure	45	psia

Cooled Drying Air

Mass Flow	161,112	lb/hr
Volume Flow	37,695	ft^3/min
Temperature	110	F
Pressure	15.4	psia

Condensate

Mass Flow	26,946	lb/hr
Temperature	110	F
Pressure	15.4	psia

Condenser Pump (P-12103)

	Inputs	
Discharge Pressure	10	psig
Isentropic Efficiency	0.72	(1 = 100%)
Brake Horsepower	0.41	hp
	0.31	kW

Condensate from Condenser

Mass Flow	26,946	lb/hr
Temperature	110.0	F
Pressure	15.4	psia

Condensate To Tank

Mass Flow	26,946	lb/hr
Temperature	110.0	F
Pressure	24.7	psia

Flue Gas Recycle

	Inputs	
Flue Gas Recycle Flowrate	0.01	lb/hr

Flue Gas Recirculation Cooler (HX-14505)

Hot stream outlet temperature	135	F
Hot stream pressure drop	-0.36	psi
Duty	1	BTU/hr
LMTD	188.7	F
Area	0.0	ft^2

Flue Gas Recirculation Blower (BL-14104)

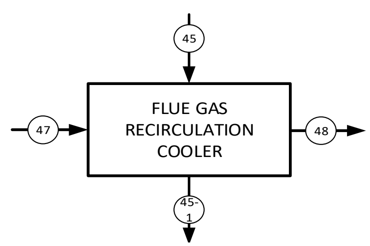
Discharge Pressure	7.36	psig
Isentropic Efficiency	0.75	(1 = 100%)
Brake Horsepower	0.00	hp
	0.00	kW

Flue Gas Recirculation Flow

Mass Flow	0	lb/hr
Volume Flow	0	ft^3/min
Temperature	573	F
Pressure	12.7	psia

Cooling Water Supply

Mass Flow	0	lb/hr
Temperature	85	F
Pressure	45	psia



Cooling Water Return

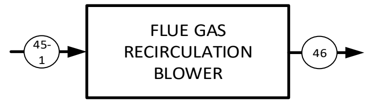
Mass Flow	0	lb/hr
Temperature	98	F
Pressure	45	psia

Flue Gas Recirculation After Cooler

Mass Flow	0	lb/hr
Volume Flow	0	ft^3/min
Temperature	135	F
Pressure	12.3	psia

Flue Gas Recirculation After Cooler

Mass Flow	0	lb/hr
Volume Flow	0	ft^3/min
Temperature	135	F
Pressure	12.3	psia



Flue Gas Recirculation To Gasifier

Mass Flow	0	lb/hr
Volume Flow	0	ft^3/min
Temperature	253	F
Pressure	21.7	psia

Aspen Stream		2	2	3	4	5	6	7	8	9	10	11	12	13-1	14	15	16				20
Stream																					
Number		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13-1**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Description		**Sludge Truck to Receiving Area**	**Feed to Dryers**	**Dried Solids from Outlet of Dryers**	**Dried Solids to Biosolids Cooling Conveyor**	**Class A Biosolids for Sale**	**Dried Solids to Holding Tanks**	**Dried Solids Feed to Gasifier**	**Coarse Biochar from Gasifier (NNF)**	**Light Biochar from Cyclone**	**Total Biochar**	**Biochar to Loadout**	**Hot Air to Dryers**	**Dryer Outlet Air**	**Condenser Outlet Air**	**Air Outlet from Heat Recovery 2**	**Air to Gasifier**	**Ambient Air for Startup Burner (NNF)**	**Natural Gas for Startup Burner (NNF)**	**Hot Air from Startup Burner to Gasifier (NNF)**	**Producer Gas from Gasifier**
Phase		**Slurry**	**Slurry**	**Solid**	**Solid**	**Solid**	**Solid**	**Solid**	**Solid**	**Solid**	**Solid**	**Solid**	**Vapor**	**Vapor**	**Vapor**	**Vapor**	**Vapor**	**Vapor**	**Vapor**	**Vapor**	**Vapor**
Total Stream Properties																					
Rate	LB/HR	35833.3	35833.3	8361.1	0.0	0.0	8361.1	8361.1	-	2085.7	2085.7	2085.7	160585.5	188057.5	161111.7	160585.5	14904.3	-	-	-	20985.5
	LB-MOL/HR	-	-	-	-	-	-	-	-	-	-	-	5686.5	7211.5	5715.7	5686.5	518.7	-	-	-	862.5
Temperature	F	80.0	80.0	185.1	185.1	100.0	185.1	135.0	-	1250.0	205.0	100.0	945.0	185.1	110.0	163.1	80.0	-	-	-	1250.0
Pressure	PSIA	14.7	14.7	14.7	14.7	14.7	14.7	14.7	-	14.1	14.1	14.1	14.7	14.7	15.4	15.1	14.7	-	-	-	14.1
Molecular Weight		-	-	-	-	-	-	-	-	-	-	-	28.2	26.1	28.2	28.2	28.7	-	-	-	24.3
Gasifier Heat Balance																					
Latent Heat, LHV	MMBTU/HR	-	-	-	-	-	-	55.1	-	4.8	-	-	-	-	-	-	-	-	-	-	40.2
Sensible Heat (Ref 60F)	MMBTU/HR	-	-	-	-	-	-	0.3	-	0.6	-	-	38.6	6.6	2.0	4.1	0.1	-	-	-	9.0
Total	MMBTU/HR	-	-	-	-	-	-	55.4	-	5.4	-	-	38.6	6.6	2.0	4.1	0.1	-	-	-	49.2
Vapor Phase Properties																					
Rate	LB/HR	-	-	-	-	-	-	-	-	-	-	-	160585.5	188057.5	161111.7	160585.5	14904.3	-	-	-	20985.5
	LB-MOL/HR	-	-	-	-	-	-	-	-	-	-	-	5686.5	7211.5	5715.7	5686.5	518.7	-	-	-	862.5
Actual Density	LB/FT3	-	-	-	-	-	-	-	-	-	-	-	0.028	0.055	0.071	0.064	0.073	-	-	-	0.019
Viscosity	CP	-	-	-	-	-	-	-	-	-	-	-	0.037	0.020	0.019	0.020	0.018	-	-	-	0.039
Molecular Weight		-	-	-	-	-	-	-	-	-	-	-	28.2	26.1	28.2	28.2	28.7	-	-	-	24.3
Heat Capacity	BTU/LB-F	-	-	-	-	-	-	-	-	-	-	-	0.272	0.280	0.250	0.250	0.243	-	-	-	0.361
HHV	BTU/LB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2178.1
LHV	BTU/LB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1913.9
Liquid Phase Properties																					
Rate	LB/HR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	LB-MOL/HR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Actual Density	LB/FT3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Viscosity	CP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Molecular Weight		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Enthalpy	BTU/LB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat Capacity	BTU/LB-F	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Component Mass Rates	**LB/HR**																				
H2O		-	-	-	-	-	-	-	-	-	-	-	6789.6	34261.7	7315.9	6789.6	196.3	-	-	-	1207.4
O2		-	-	-	-	-	-	-	-	-	-	-	35589.2	35589.2	35589.1	35589.2	3403.5	-	-	-	-
N2		-	-	-	-	-	-	-	-	-	-	-	116143.8	116143.7	116143.7	116143.8	11107.2	-	-	-	11245.3
NOx		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NH3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	327.2
C		-	-	-	-	-	-	-	-	337.7	337.7	337.7	-	-	-	-	-	-	-	-	-
CO		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2993.4
CO2		-	-	-	-	-	-	-	-	-	-	-	81.8	81.8	81.8	81.8	7.8	-	-	-	4171.2
CH4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	428.2
CHN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37.0
COS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.0
H2O		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	276.7
H2S		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	102.7
S		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
SO2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0
ARGON		-	-	-	-	-	-	-	-	-	-	-	1981.1	1981.1	1981.1	1981.1	189.5	-	-	-	189.5
CA(OH)2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CALCI-02		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ASH		-	-	-	-	-	-	-	-	1748.0	1748.0	1748.0	-	-	-	-	-	-	-	-	194.2
BIOMASS		35833.3	35833.3	8361.1	0.0	0.0	8361.1	8361.1	-	-	-	-	-	-	-	-	-	-	-	-	-
Non Biomass Component Mol Fractions																					
H2O		-	-	-	-	-	-	-	-	-	-	-	0.066	0.264	0.071	0.066	0.021	-	-	-	0.078
O2		-	-	-	-	-	-	-	-	-	-	-	0.196	0.154	0.195	0.196	0.205	-	-	-	-
N2		-	-	-	-	-	-	-	-	-	-	-	0.729	0.575	0.725	0.729	0.764	-	-	-	0.465
NOx		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NH3		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.022
C		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.124
CO2		-	-	-	-	-	-	-	-	-	-	-	0.000	0.000	0.000	0.000	0.000	-	-	-	0.110
CH4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.031
CHN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.002
COS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
H2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.159
H2S		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.003
S		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
SO2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.000
ARGON		-	-	-	-	-	-	-	-	-	-	-	0.009	0.007	0.009	0.009	0.009	-	-	-	0.005
CA(OH)2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CALCI-02		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biomass Mass Percent																					
ASH		5.420	5.420	26.887	26.887	26.887	26.887	26.887	-	-	-	-	-	-	-	-	-	-	-	-	-
NITROGEN		1.190	1.190	5.273	5.273	5.273	5.273	5.273	-	-	-	-	-	-	-	-	-	-	-	-	-
OXYGEN		4.160	4.160	16.301	16.301	16.301	16.301	16.301	-	-	-	-	-	-	-	-	-	-	-	-	-
HYDROGEN		1.310	1.310	5.031	5.031	5.031	5.031	5.031	-	-	-	-	-	-	-	-	-	-	-	-	-
CARBON		8.640	8.640	34.857	34.857	34.857	34.857	34.857	-	-	-	-	-	-	-	-	-	-	-	-	-
SULFUR		0.280	0.280	1.650	1.650	1.650	1.650	1.650	-	-	-	-	-	-	-	-	-	-	-	-	-
MOISTURE		79.000	79.000	10.000	10.000	10.000	10.000	10.000	-	-	-	-	-	-	-	-	-	-	-	-	-
Char Mass Percent																					
ASH		-	-	-	-	-	-	-	-	83.808	83.808	83.808	-	-	-	-	-	-	-	-	-
NITROGEN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OXYGEN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HYDROGEN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CARBON		-	-	-	-	-	-	-	-	16.192	16.192	16.192	-	-	-	-	-	-	-	-	-
SULFUR		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOISTURE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Aspen Stream		21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Stream																					
Number		**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Description		**Flue Gas from Thermal Oxidizer**	**Flue Gas to Emission Control**	**Emission Control Outlet**	**Flue Gas to ID Fan**	**Flue Gas To Stack**	**CWS to Dryer Condensers**	**CWR from Dryer Condensers**	**CWS to Gasifier Feed Conveyors**	**CWR from Gasifier Feed Conveyors**	**CWS to Biochar Cooling Conveyor**	**CWR from Biochar Cooling Conveyor**	**CWS to Biochar Loadout Conveyor**	**CWR from Biochar Loadout Conveyor**	**CWS to Biosolids Loadout Conveyor**	**CWR from Biosolids Loadout Conveyor**	**Water from Dryer Condenser**	**Condensate from Holding Tank to Treatment Plant**	**Ambient Air for Thermal Oxidizer**	**Natural Gas for Thermal Oxidizer (NNF)**	**Cold Air Makeup to Dryer Loop**
Phase		**Vapor**	**Vapor**	**Vapor**	**Vapor**	**Vapor**	**Liquid**	**Liquid**	**Liquid**	**Liquid**	**Liquid**	**Liquid**	**Liquid**	**Liquid**	**Liquid**	**Liquid**	**Liquid**	**Liquid**	**Vapor**	**Vapor**	**Vapor**
Total Stream Properties																					
Rate	LB/HR	101810.7	101810.7	101938.3	101938.3	101938.3	2606987.0	2606987.0	14723.5	14723.5	44021.5	44021.5	3220.7	3220.7	0.0	0.0	26945.9	26945.9	64714.0	0.0	15585.0
	LB-MOL/HR	3565.9	3565.9	3583.5	3583.5	3583.5	144709.8	144709.8	817.2	817.2	2443.6	2443.6	178.8	178.8	0.0	0.0	1495.7	1495.7	2252.1	0.0	542.4
Temperature	F	1800.0	700.0	650.0	572.8	637.8	85.0	98.0	85.0	98.0	85.0	98.0	85.0	98.0	85.0	98.0	110.0	110.0	80.0	80.0	80.0
Pressure	PSIA	13.8	13.4	13.1	12.7	15.7	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	15.4	24.7	14.7	14.7	14.7
Molecular Weight		28.6	28.6	28.4	28.4	28.4	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	28.7	16.0	28.7
Gasifier Heat Balance																					
Latent Heat, LHV	MMBTU/HR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sensible Heat (Ref 60F)	MMBTU/HR	54.4	17.7	16.2	14.0	15.9	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.0	0.1
Total	MMBTU/HR	54.4	17.7	16.2	14.0	15.9	-	-	-	-	-	-	-	-	-	-	-	-	0.3	0.0	0.1
Vapor Phase Properties																					
Rate	LB/HR	101810.7	101810.7	101938.3	101938.3	101938.3	-	-	-	-	-	-	-	-	-	-	-	-	64714.0	0.0	15585.0
	LB-MOL/HR	3565.9	3565.9	3583.5	3583.5	3583.5	-	-	-	-	-	-	-	-	-	-	-	-	2252.1	0.0	542.4
Actual Density	LB/FT3	0.016	0.031	0.031	0.033	0.038	-	-	-	-	-	-	-	-	-	-	-	-	0.073	0.041	0.073
Viscosity	CP	0.050	0.032	0.031	0.029	0.030	-	-	-	-	-	-	-	-	-	-	-	-	0.018	0.011	0.018
Molecular Weight		28.6	28.6	28.4	28.4	28.4	-	-	-	-	-	-	-	-	-	-	-	-	28.7	16.0	28.7
Heat Capacity	BTU/LB-F	0.307	0.271	0.270	0.267	0.270	-	-	-	-	-	-	-	-	-	-	-	-	0.243	0.534	0.243
HHV	BTU/LB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LHV	BTU/LB	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liquid Phase Properties																					
Rate	LB/HR	-	-	-	-	-	2606987.0	2606987.0	14723.5	14723.5	44021.5	44021.5	3220.7	3220.7	0.0	0.0	26945.9	26945.9	-	-	-
	LB-MOL/HR	-	-	-	-	-	144709.8	144709.8	817.2	817.2	2443.6	2443.6	178.8	178.8	0.0	0.0	1495.7	1495.7	-	-	-
Actual Density	LB/FT3	-	-	-	-	-	62.2	62.0	62.2	62.0	62.2	62.0	62.2	62.0	62.2	62.0	60.9	60.9	-	-	-
Viscosity	CP	-	-	-	-	-	0.807	0.696	0.807	0.696	0.807	0.696	0.807	0.696	0.807	0.696	0.630	0.630	-	-	-
Molecular Weight		-	-	-	-	-	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	-	-	-
Enthalpy	BTU/LB	-	-	-	-	-	-6813.0	-6800.1	-6813.0	-6800.1	-6813.0	-6800.1	-6813.0	-6800.1	-6813.0	-6800.1	-6831.1	-6831.1	-	-	-
Heat Capacity	BTU/LB-F	-	-	-	-	-	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.1	1.1	-	-	-
Component Mass Rates	**LB/HR**																				
H2O		6811.3	6811.3	7197.8	7197.8	7197.8	2606987.0	2606987.0	14723.5	14723.5	44021.5	44021.5	3220.7	3220.7	0.0	0.0	26945.8	26945.8	852.3	-	205.3
O2		11987.4	11987.4	11913.7	11913.7	11913.7	-	-	-	-	-	-	-	-	-	-	0.0	0.0	14778.0	-	3559.0
N2		71344.6	71344.6	71431.3	71431.3	71431.3	-	-	-	-	-	-	-	-	-	-	0.0	0.0	48227.1	-	11614.5
NOx		100.1	100.1	5.0	5.0	5.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NH3		-	-	3.6	3.6	3.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO2		10156.7	10156.7	10156.7	10156.7	10156.7	-	-	-	-	-	-	-	-	-	-	0.0	0.0	34.0	-	8.2
CH4		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0	-
CHN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H2O		0.0	0.0	0.0	0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
H2S		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
S		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SO2		200.5	200.5	20.0	20.0	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ARGON		1210.2	1210.2	1210.2	1210.2	1210.2	-	-	-	-	-	-	-	-	-	-	0.0	0.0	822.6	-	198.1
CA(OH)2		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CALCI-02		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ASH		194.2	194.2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BIOMASS		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Non Biomass Component Mol Fractions																					
H2O		0.106	0.106	0.111	0.111	0.111	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	0.021	-	0.021
O2		0.105	0.105	0.104	0.104	0.104											0.000	0.000	0.205	-	0.205
N2		0.714	0.714	0.712	0.712	0.712											0.000	0.000	0.764	-	0.764
NOx		0.001	0.001	0.000	0.000	0.000											-	-	-	-	-
NH3		-	-	0.000	0.000	0.000											-	-	-	-	-
C		-	-	-	-	-											-	-	-	-	-
CO		-	-	-	-	-											-	-	-	-	-
CO2		0.065	0.065	0.064	0.064	0.064											0.000	0.000	0.000	-	0.000
CH4		-	-	-	-	-											-	-	-	1.000	-
CHN		-	-	-	-	-											-	-	-	-	-
COS		-	-	-	-	-											-	-	-	-	-
H2		0.000	0.000	0.000	0.000	0.000											-	-	-	-	-
H2S		-	-	-	-	-											-	-	-	-	-
S		-	-	-	-	-											-	-	-	-	-
SO2		0.001	0.001	0.000	0.000	0.000											-	-	-	-	-
ARGON		0.008	0.008	0.008	0.008	0.008											0.000	0.000	0.009	-	0.009
CA(OH)2		-	-	-	-	-											-	-	-	-	-
CALCI-02		-	-	-	-	-											-	-	-	-	-
Biomass Mass Percent																					
ASH		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NITROGEN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OXYGEN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HYDROGEN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CARBON		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SULFUR		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOISTURE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Char Mass Percent																					
ASH		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
NITROGEN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OXYGEN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
HYDROGEN		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CARBON		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
SULFUR		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
MOISTURE		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Aspen Stream		41	42	43	44	45	46	47	48
Stream									
Number		**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
Description		**Sorbent Injection**	**Ammonia Injection**	**Spent Sorbent**	**Drying Gas Purge to Thermal Oxidizer**	**Flue Gas Recirculation before HX-14505**	**Flue Gas Recirculation to Gasifier**	**CWS to FGD Cooler**	**CWR from FGD Cooler**
Phase		**Solid**	**Liquid**	**Mixed**	**Vapor**	**Vapor**	**Vapor**	**Liquid**	**Liquid**
Total Stream Properties									
Rate	LB/HR	540.2	389.4	801.8	16111.2	0.0	0.0	0.0	0.0
	LB-MOL/HR	7.3	21.9	7.3	571.6	0.0	0.0	0.0	0.0
Temperature	F	80.0	80.0	650.0	110.0	572.8	252.8	85.0	98.0
Pressure	PSIA	14.7	14.7	13.1	15.4	12.7	21.7	45.0	45.0
Molecular Weight		74.1	17.8	110.0	28.2	28.4	28.4	18.0	18.0
Gasifier Heat Balance									
Latent Heat, LHV	MMBTU/HR	-	-	-				-	-
Sensible Heat (Ref 60F)	MMBTU/HR	-	-	-				-	-
Total	MMBTU/HR	-	-	-				-	-
Vapor Phase Properties									
Rate	LB/HR	-	-	-	16111.2	0.0	0.0	-	-
	LB-MOL/HR	-	-	-	571.6	0.0	0.0	-	-
Actual Density	LB/FT3	-	-	-	0.071	0.033	0.081	-	-
Viscosity	CP	-	-	-	0.019	0.029	0.022	-	-
Molecular Weight		-	-	-	28.2	28.4	28.4	-	-
Heat Capacity	BTU/LB-F	-	-	-	0.250	0.267	0.258	-	-
HHV	BTU/LB	-	-	-	-	-	-	-	-
LHV	BTU/LB	-	-	-	-	-	-	-	-
Liquid Phase Properties									
Rate	LB/HR	-	389.4	-	-	-	-	0.0	0.0
	LB-MOL/HR	-	21.9	-	-	-	-	0.0	0.0
Actual Density	LB/FT3	-	56.4	-	-	-	-	62.2	62.0
Viscosity	CP	-	0.601	-	-	-	-	0.807	0.696
Molecular Weight		-	17.8	-	-	-	-	18.0	18.0
Enthalpy	BTU/LB	-	-5927.4	-	-	-	-	-6813.0	-6800.1
Heat Capacity	BTU/LB-F	-	1.1	-	-	-	-	1.0	1.0
Component Mass Rates	**LB/HR**								
H2O		-	315.4	-	731.6	0.0	0.0	0.0	0.0
O2		-	-	-	3558.9	0.0	0.0	-	-
N2		-	-	-	11614.4	0.0	0.0	-	-
NOx		-	-	-	-	0.0	0.0	-	-
NH3		-	74.0	-	-	0.0	0.0	-	-
C		-	-	-	-	-	-	-	-
CO		-	-	-	-	-	-	-	-
CO2		-	-	-	8.2	0.0	0.0	-	-
CH4		-	-	-	-	-	-	-	-
CHN		-	-	-	-	-	-	-	-
COS		-	-	-	-	-	-	-	-
H2O		-	-	-	-	0.0	0.0	-	-
H2S		-	-	-	-	-	-	-	-
S		-	-	-	-	-	-	-	-
SO2		-	-	-	-	0.0	0.0	-	-
ARGON		-	-	-	198.1	0.0	0.0	-	-
CA(OH)2		540.2	-	331.6	-	-	-	-	-
CALCI-02		-	-	436.4	-	-	-	-	-
ASH		-	-	194.2	-	-	-	-	-
BIOMASS		-	-	-	-	-	-	-	-
Non Biomass Component Mol Fractions									
H2O		-	0.801	-	0.071	0.111	0.111	1.000	1.000
O2		-	-	-	0.195	0.104	0.104		
N2		-	-	-	0.725	0.712	0.712		
NOx		-	-	-	-	0.000	0.000		
NH3		-	0.199	-	-	0.000	0.000		
C		-	-	-	-	-	-		
CO		-	-	-	-	-	-		
CO2		-	-	-	0.000	0.064	0.064		
CH4		-	-	-	-	-	-		
CHN		-	-	-	-	-	-		
COS		-	-	-	-	-	-		
H2		-	-	-	-	0.000	0.000		
H2S		-	-	-	-	-	-		
S		-	-	-	-	-	-		
SO2		-	-	-	-	0.000	0.000		
ARGON		-	-	-	0.009	0.008	0.008		
CA(OH)2		1.000	-	0.614	-	-	-		
CALCI-02		-	-	0.348	-	-	-		
Biomass Mass Percent									
ASH		-	-	-	-	-	-	-	-
NITROGEN		-	-	-	-	-	-	-	-
OXYGEN		-	-	-	-	-	-	-	-
HYDROGEN		-	-	-	-	-	-	-	-
CARBON		-	-	-	-	-	-	-	-
SULFUR		-	-	-	-	-	-	-	-
MOISTURE		-	-	-	-	-	-	-	-
Char Mass Percent									
ASH		-	-	-	-	-	-	-	-

NITROGEN	-	-	-	-	-	-	-	-												
OXYGEN	-	-	-	-	-	-	-	-												
HYDROGEN	-	-	-	-	-	-	-	-												
CARBON	-	-	-	-	-	-	-	-												
SULFUR	-	-	-	-	-	-	-	-												
MOISTURE	-	-	-	-	-	-	-	-												

Emissions Calculation

DEP Program Interest No. (PI #)
DEP Pre Construction Permit ID No (PCP #)

Operating Scenario Maintenance Operation - Gasifier Down
NJID OS8

Uncontrolled Emissions from Auxiliary Heaters - Criteria Pollutants

100 Heat Input (MMBtu/hr)

Fuel Type: **Natural Gas** Used: y

	Pollutant						
	PM	PM_{10}[2]	$PM_{2.5}$	SO_2	NO_X	CO	VOC
Emission Factor[1] (lb/MMSCF)	7.6	7.6	7.6	0.6	11.22	84	5.5
PTE (ton/yr)	**3.2635**	**3.2635**	**3.2635**	**0.2576**	**4.8180**	**36.0706**	**2.3618**
PTE (lbs/hr)	**0.7451**	**0.7451**	**0.7451**	**0.0588**	**1.1000**	**8.2353**	**0.5392**

Note:
1. Emission factors are from AP-42, Chapter 1.4, Tables 1.4-1 and 1.4-2 (updated 07/98).
2. Assumed PM and $PM_{2.5}$ emissions are equal to PM_{10} emissions.
3. If in extreme or severe ozone nonattainment, NOx emission factor reflects NOx limit in general permit
4. Formaldehyde is the largest HAP component. Combined HAPs is formaldehyde plus all other HAP components from Table 1.4-3 and 1.4-4 in AP-42.

Methodology
PTE (ton/yr) = Heat Input (MMBtu/hr) x 1 MMSCF/1,020 MMBtu x EF (lb/MMSCF) x 8760 hr/yr x 1 ton/2000 lb

E8 and E9 Particulate Matter Emissions Calculation

Biosolids	Hours/Year	Days/Year	Solids Loaded tons/day	Total Fines	Fines as Dust	Uncontrolled PM10 Emissions ton/year
PM10 Emissions OS9 - Bin Loading	8250	343.8	13.3	5%	1%	**2.3**
PM10 Emissions OS10 - Truck Loadout Fugitive Emissions	2920	121.7	13.3	5%	5%	**4.0**
PM2.5Emissions OS9 - Bin Loading	8250	343.8	13.3	5%	1%	**2.3**
PM2.5 Emissions OS10 - Truck Loadout Fugitive Emissions	2920	121.7	13.3	5%	5%	**4.0**
Biochar						
PM10 Emissions OS11 - Bin Loading	8250	343.8	25	25%	1%	**21.5**
PM10 Emissions OS12 - Truck Loadout Fugitive Emissions	2920	121.7	25	25%	5%	**38.0**
PM2.5 Emissions OS11 - Bin Loading	8250	343.8	25	25%	1%	**21.5**
PM2.5 Emissions OS12 - Truck Loadout Fugitive Emissions	2920	121.7	25	25%	5%	**38.0**

Notes:

1. OS9 are dust emissions while the bin is loading. This occurs anytime and therefore theoretically operates 8,760 hours per year.
2. OS11 are dust emissions while the bin is loading. This occurs anytime the gasifier is operating and therefore operates 8,250 hours per year.
3. OS10 and OS12 occur only during truck loadout which occurs approximately once a day, and takes approximately 1 hour therefore 365 hours/year.
4. When loading the bin assumed dust settles within the bin so fines as dust are 1%.
5. When loading the truck there is transfer that occurs between the bin and the truck enclosed in a chute, fines as dust are expected to be higher (5%).
6. All PM Emissions are assumed to be PM 2.5 and greater

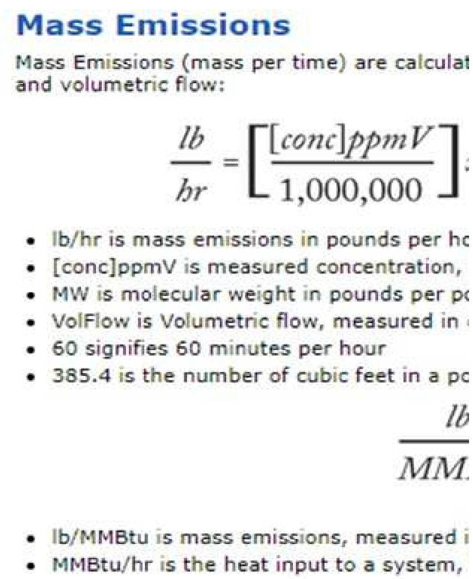
Aries Clean Energy -Newark Sludge Processing Plant

400 Doremus Ave Newark, NJ

Hazardous Air Pollutants (HAP) Calculations

PM HAP Uncontrolled Emission Factor calculations				
HAP	Uncontrolled[1]	Average Flowrate	MW	Uncontrolled
	lb/hr	DSCFM	lb/lb-mol	ppm
HCl	4.50E-01	1525.00	36.46	5.20E+01
HF	3.00E-02	1525.00	20.02	6.31E+00
Arsenic	1.19E-05	1525.00	74.92	6.69E-04
Beryllium	5.59E-07	1525.00	9.01	2.61E-04
Cadmium	5.73E-05	1525.00	112.41	2.15E-03
Chromium	2.33E-02	1525.00	52.00	1.89E+00
Lead	5.90E-04	1525.00	207.2	1.20E-02
Mercury	1.35E-04	1525.00	200.59	2.83E-03
Nickel	1.22E-02	1525.00	58.693	8.76E-01

1 - Uncontrolled emission rates from Table 6.1


Mass Emissions

Mass Emissions (mass per time) are calculat
and volumetric flow:

$$\frac{lb}{hr} = \left[\frac{[conc]ppmV}{1,000,000}\right]$$

- lb/hr is mass emissions in pounds per ho
- [conc]ppmV is measured concentration,
- MW is molecular weight in pounds per po
- VolFlow is Volumetric flow, measured in
- 60 signifies 60 minutes per hour
- 385.4 is the number of cubic feet in a po

$$\frac{lb}{MM}$$

- lb/MMBtu is mass emissions, measured i
- MMBtu/hr is the heat input to a system,

EU1, OS1 and OS2	**Sludge Receiving 1 and 2**

NJDEP DIVISION OF AIR QUALITY RISK SCREENING WORKSHEET
For Long-Term Carcinogenic and Noncarcinogenic Effects and Short-Term Effects

August 2018

Read the Instructions tab carefully before completing this spreadsheet.

Date	7/23/2020
Facility ID No.	
Activity ID No.	
Facility name	Aries Clean Energy - Newark Gasification Plant
Facility location	Newark, NJ
File name (.xls)	Aries Clean Energy-Newark Gasification Plant-Level 1 Risk

Emission Unit/Batch Process ID No.	EU1	Stack height[1]	140.0	ft
Emission Point ID No.	PT3	Distance to property line	96	ft
Equipment ID No(s).	E7	**Annual air impact value, C'**	0.5051	**$(ug/m^3)/(ton/yr)$**
Operating Scenario(s)	OS7	**24-hour air impact value, C'_{st}**	8.99	**$(ug/m^3)/(lb/hr)$**

KEY:

Long-Term Effects

Q = Annual emission rate (in tons per year) contributed from the source
C = C' x Q = Annual average ambient air concentration
URF = Unit risk factor (for carcinogenic risk)
IR = C x URF = Incremental risk (for carcinogen)
RfC = Reference concentration (for noncarcinogenic effects)
HQ = C/RfC = Hazard quotient (for noncarcinogenic risk)
Rslt = The result of comparing the IR or HQ to the negligible threshold (FER if > threshold, Negl. if <= threshold)
FER = Further Evaluation Required (See Notes for thresholds)
Negl. = Negligible (See Notes for thresholds)

Short-Term Effects

Q_h = Hourly emission rate (in pounds per hour)
C_{st} = C'_{st} x Q_h = Short-term average ambient air concentration
RfC_{st} = Short-term reference concentration (for noncarcinogenic effects)
HQ_{st} = C_{st}/RfC_{st} = Hazard quotient for short-term noncarcinogenic effects
Rslt = The result of comparing the HQ_{st} to the negligible threshold (FER if > threshold, Negl. if <= threshold)
FER = Further Evaluation Required (See Notes for thresholds)
Negl. = Negligible (See Notes for thresholds)

[1] When evaluating risk for diesel engines, use the equivalent stack height consistent with the memo dated June 10, 2009.
Click here to view the "Stack Height Equivalents for Use in First Level Screening Analyses for Diesel Engines" memo.

Aries Clean Energy - Newark Gasification Plant

				LONG-TERM EFFECTS								SHORT-TERM EFFECTS				
	H A P	CAS No.	Air Toxic	Q (ton/yr)	C (ug/m^3)	URF $[(ug/m^3)^{-1}]$	IR	Rslt	RfC (ug/m^3)	HQ	Rslt	Q_h (lb/hr)	C_{st} (ug/m^3)	RfC_{st} (ug/m^3)	HQ_{st}	Rslt
1	*	75070	Acetaldehyde			2.2E-06			9					470		
2	*	60355	Acetamide			2.0E-05										
3		67641	Acetone						31000					62000		
4		75865	Acetone cyanohydrin						2							
5	*	75058	Acetonitrile						60							
6	*	98862	Acetophenone						0.02							
7	*	53963	Acetylaminofluorene (2-)			1.3E-03										
8	*	107028	Acrolein						0.02					2.5		
9	*	79061	Acrylamide			1.0E-04			6							
10	*	79107	Acrylic acid						1					6000		
11	*	107131	Acrylonitrile			6.8E-05			2							
12		309002	Aldrin			4.9E-03										
13	*	107051	Allyl chloride			6.0E-06			1							
14		117793	Aminoanthraquinone (2-)			9.4E-06										
15	*	92671	Aminobiphenyl (4-)			6.0E-03										
16		7664417	Ammonia						100					3200		
17	*	62533	Aniline			1.6E-06			1					3000		
18	*	90040	Anisidine (o-)			4.0E-05										
19	**	1309644	Antimony trioxide						0.2							
20		140578	Aramite			7.1E-06										
21	*		Arsenic (inorganic)	6.5E-06	3.3E-06	4.3E-03	**1.4E-08**	**Negl.**	0.015	**2.2E-04**	**Negl.**	1.6E-06	3.5E-05	0.2	**1.8E-04**	**Negl.**
22	**	7784421	Arsine						0.05							
23	*	1332214	Asbestos			7.7E-03										
24		103333	Azobenzene			3.1E-05										
25			Barium											0.5		
26	*	71432	Benzene			7.8E-06			3					27		
27	*	92875	Benzidine			6.7E-02										
28	**	50328	Benzo(a)pyrene			1.1E-03										
29	*	98077	Benzotrichloride			3.7E-03										
30	*	100447	Benzyl chloride			4.9E-05								240		
31	*		Beryllium			2.4E-03			0.02							
32	*	92524	Biphenyl (1,1-)						0.4							
33		108601	Bis(2-chloroisopropyl)ether			1.0E-05										
34	*	117817	Bis(2-ethylhexyl)phthalate			2.4E-06										
35	*	542881	Bis(chloromethyl)ether			6.2E-02										
36		7440428	Boron (elemental)						20							
37		7637072	Boron trifluoride						0.7							
38		74975	Bromochloromethane						40							
39		75274	Bromodichloromethane			3.7E-05										
40	*	75252	Bromoform			1.1E-06										
41	*	106990	Butadiene (1,3-)			3.0E-05			2					660		
42	*		Cadmium	3.0E-05	1.5E-05	4.2E-03	**6.4E-08**	**Negl.**	0.02	**7.6E-04**	**Negl.**	7.3E-06	0.00016			
43		105602	Caprolactam						2.2					50		
44	*	133062	Captan			6.6E-07										
45	*	75150	Carbon disulfide						700					6200		
46	*	56235	Carbon tetrachloride			6.0E-06			40					1900		
47	*	57749	Chlordane			1.0E-04			0.7							
48		108171262	Chlorinated paraffins			2.0E-05										
49	*	7782505	Chlorine						0.2					210		
50		10049044	Chlorine dioxide						0.2					28		
51		75683	Chloro-1,1-difluoroethane (1-) *(HCFC-142b)*						50000							
52	*	532274	Chloroacetophenone (2-)						0.03							
53	*	108907	Chlorobenzene						1000							
54	*	510156	Chlorobenzilate			3.1E-05										
55		75456	Chlorodifluoromethane *(HCFC-22)*						50000							
56	*	67663	Chloroform			2.3E-05			300					150		
57	*	107302	Chloromethyl methyl ether			6.9E-04										
58		95830	Chloro-o-phenylenediamine (4-)			4.6E-06										
59		95692	Chloro-o-toluidine (p-)			7.7E-05										
60		76062	Chloropicrin						0.4					29		
61	*	126998	Chloroprene			5.0E-04			20							
62		75296	Chloropropane (2-)						100							
63	**		Chromic acid mists (Cr VI)						0.008							
64	**	18540299	Chromium VI (total)			1.2E-02										
65	**		Chromium VI dissolved aerosols						0.008							
66	**		Chromium VI particulates						0.1							
67	*		Cobalt			9.0E-03			0.006							
68	*	8007452	Coke oven emissions			6.2E-04										
69			Copper											100		
70		120718	Cresidine (p-)			4.3E-05										
71	*		Cresol mixtures						600							
72		98828	Cumene						400							
73		135206	Cupferron			6.3E-05										
74		110827	Cyclohexane											6000		
75	*	72559	DDE			9.7E-05										
76		50293	DDT			9.7E-05										

Aries Clean Energy - Newark Gasification Plant

	HAP	CAS No.	Air Toxic	LONG-TERM EFFECTS								SHORT-TERM EFFECTS				
				Q (ton/yr)	C (ug/m^3)	URF $[(ug/m^3)^{-1}]$	IR	Rslt	RfC (ug/m^3)	HQ	Rslt	Q_h (lb/hr)	C_{st} (ug/m^3)	RfC_{st} (ug/m^3)	HQ_{st}	Rslt
77		615054	Diaminoanisole (2,4-)			6.6E-06										
78		124481	Dibromochloromethane			2.7E-05										
79	*	96128	Dibromo-3-chloropropane (1,2-)			2.0E-03			0.2							
80		764410	Dichloro-2-butene (1,4-)			4.2E-03										
81		95501	Dichlorobenzene (1,2-)						200							
82	*	106467	Dichlorobenzene (1,4-)			1.1E-05			800							
83	*	91941	Dichlorobenzidine (3,3'-)			3.4E-04										
84		75718	Dichlorodifluoromethane						100							
85	*	111444	Dichloroethyl ether			3.3E-04										
86	*	542756	Dichloropropene (1,3-)			4.0E-06			20							
87	*	62737	Dichlorvos			8.3E-05			0.5							
88		77736	Dicyclopentadiene						0.3							
89		60571	Dieldrin			4.6E-03										
90			Diesel particulate matter			3.0E-04			5							
91	*	111422	Diethanolamine						3							
92		112345	Diethylene glycol monobutyl ether						0.1							
93		75376	Difluoroethane (1,1-)						40000							
94	*	77781	Dimethyl sulfate			4.0E-03										
95	*	60117	Dimethylaminoazobenzene (4-)			1.3E-03										
96	*	79447	Dimethylcarbamyl chloride			3.7E-03										
97	*	68122	Dimethylformamide (N,N-)						30							
98	*	57147	Dimethylhydrazine (1,1-)						0.002							
99		540738	Dimethylhydrazine (1,2-)			1.6E-01										
100	*	121142	Dinitrotoluene (2,4-)			8.9E-05										
101	*	123911	Dioxane (1,4-)			5.0E-06			30					3000		
102	*		Dioxin						See footnote "a"							
103	*	122667	Diphenylhydrazine (1,2-)			2.2E-04										
104	*	106898	Epichlorohydrin			1.2E-06			1					1300		
105	*	106887	Epoxybutane (1,2-)						20							
106	*	140885	Ethyl acrylate						8							
107	*	100414	Ethylbenzene			2.5E-06								1000		
108	*	51796	Ethyl carbamate			2.9E-04										
109	*	75003	Ethyl chloride											10000		
110	*	106934	Ethylene dibromide			6.0E-04			0.8							
111	*	107062	Ethylene dichloride			2.6E-05			400							
112	*	107211	Ethylene glycol						400							
113	*	111762	Ethylene glycol monobutyl ether						1600					14000		
114	**	110805	Ethylene glycol monoethyl ether						200					370		
115	**	111159	Ethylene glycol monoethyl ether acetate						300					140		
116	**	109864	Ethylene glycol monomethyl ether						20					93		
117	**	110496	Ethylene glycol monomethyl ether acetate						90							
118	*	75218	Ethylene oxide			3.0E-03			30					42		
119	*	96457	Ethylene thiourea			1.3E-05										
120	*	151564	Ethyleneimine			1.9E-02										
121	*	75343	Ethylidene dichloride			1.6E-06			500							
122		16984488	Fluoride						13							
123	*	50000	Formaldehyde			1.3E-05			9					55		
124		98011	Furfural						50							
125			Gasoline vapors			1.0E-06			15							
126		111308	Glutaraldehyde						0.08							
127		765344	Glycidaldehyde						1							
128	*	76448	Heptachlor			1.3E-03										
129		1024573	Heptachlor epoxide			2.6E-03										
130	*	118741	Hexachlorobenzene			4.6E-04										
131	*	87683	Hexachlorobutadiene			2.2E-05										
132	**	319846	Hexachlorocyclohexane (alpha-)			1.8E-03										
133	**	319857	Hexachlorocyclohexane (beta-)			5.3E-04										
134	*	58899	Hexachlorocyclohexane (gamma-)			3.1E-04										
135	**	608731	Hexachlorocyclohexane (technical grade)			5.1E-04										
136	*	77474	Hexachlorocyclopentadiene						0.2							
137		19408743	Hexachlorodibenzo-p-dioxin, mixture			1.3E+00										
138	*	67721	Hexachloroethane			1.1E-05			30							
139	*	822060	Hexamethylene diisocyanate						0.01							
140	*	110543	Hexane (N-)						700							
141	*	302012	Hydrazine			4.9E-03			0.2					10		
142		10034932	Hydrazine sulfate			4.9E-03										
143	*	7647010	Hydrogen chloride	1.0E+00	5.1E-01				20	**2.5E-02**	**Negl.**	2.4E-01	5.45284	2100	**2.6E-03**	**Negl.**
144	**	74908	Hydrogen cyanide						0.8					340		
145	*	7664393	Hydrogen fluoride						14					240		
146	**	7783075	Hydrogen selenide											5		
147		7783064	Hydrogen sulfide						2					42		
148	*	78591	Isophorone						2000							
149		67630	Isopropanol											3200		
150	*		Lead			1.2E-05								0.1		
151	*	108316	Maleic anhydride						0.7							
152	*		Manganese						0.05					0.17		
153	*		Mercury (elemental)						0.3							
154	*	7439976	Mercury (inorganic)						0.03					0.6		
155		126987	Methacrylonitrile						0.7							
156	*	67561	Methanol						4000					28000		
157	*	74839	Methyl bromide						5					3900		
158	*	74873	Methyl chloride			1.8E-06			90							
159	*	71556	Methyl chloroform						1000					9000		
160		78933	Methyl ethyl ketone						5000					13000		
161	*	108101	Methyl isobutyl ketone											3000		
162	*	624839	Methyl isocyanate						1							
163	*	80626	Methyl methacrylate						700							
164		25013154	Methyl styrene (mixed isomers)						40							
165	*	1634044	Methyl tert butyl ether			2.6E-07			3000							
166		108872	Methylcyclohexane						3000							
167	*	101144	Methylene bis(2-chloroaniline) (4,4'-)			4.3E-04										
168	*	75092	Methylene chloride			1.3E-08			600					14000		
169	*	101779	Methylenedianiline (4,4-)			4.6E-04			20							
170	*	101688	Methylenediphenyl diisocyanate (4,4'-)						0.6							
171	*	60344	Methylhydrazine			1.0E-03			0.02							
172		90948	Michler's ketone			2.5E-04										
173	*		Mineral fibers (<1% free silica)						24							
174	*	91203	Naphthalene			3.4E-05			3							
175	*		Nickel and compounds	6.8E-03	3.4E-03	2.4E-04	**8.2E-07**	**Negl.**	0.014	**2.4E-01**	**Negl.**	1.6E-03	0.03697	0.2	**1.8E-01**	**Negl.**
176	**	1313991	Nickel oxide						0.02							
177	**		Nickel, soluble salts						0.2							
178		7697372	Nitric acid											86		
179		88744	Nitroaniline (o-)						0.05							
180	*	98953	Nitrobenzene			4.0E-05			9							
181	*	79469	Nitropropane (2-)			2.7E-03			20							
182		55185	Nitrosodiethylamine (N-)			4.3E-02										
183	*	62759	Nitrosodimethylamine (N-)			1.4E-02										
184		924163	Nitrosodi-n-butylamine (N-)			1.6E-03										

Aries Clean Energy - Newark Gasification Plant

	H A P	CAS No.	Air Toxic	LONG-TERM EFFECTS Q (ton/yr)	C (ug/m^3)	URF [(ug/m^3)$^{-1}$]	IR	Rslt	RfC (ug/m^3)	HQ	Rslt	SHORT-TERM EFFECTS Q_h (lb/hr)	C_{st} (ug/m^3)	RfC_{st} (ug/m^3)	HQ_{st}	Rslt
185		621647	Nitrosodi-n-propylamine (N-)			2.0E-03										
186		86306	Nitrosodiphenylamine (N-)			2.6E-06										
187		156105	Nitrosodiphenylamine (p-)			6.3E-06										
188		10595956	Nitrosomethylethylamine (N-)			6.3E-03										
189	*	59892	Nitrosomorpholine (N-)			1.9E-03										
190		759739	Nitroso-n-ethylurea (N-)			7.7E-03										
191	*	684935	Nitroso-n-methylurea (N-)			3.4E-02										
192		100754	Nitrosopiperidine (N-)			2.7E-03										
193		930552	Nitrosopyrrolidine (N-)			6.1E-04										
194	*	87865	Pentachlorophenol			5.1E-06										
195	*	108952	Phenol						200					5800		
196	*	75445	Phosgene						0.3					4		
197	*	7803512	Phosphine						0.3							
198	*	7664382	Phosphoric acid						10							
199	*		Phosphorus (white)						0.07							
200	*	85449	Phthalic anhydride						20							
201	*	1336363	Polychlorinated biphenyls (PCBs)			1.0E-04										
202	*		Polycylic aromatic hydrocarbons (PAHs)	See footnote "b"												
203	*		Polycylic organic matter (POM)													
204		7758012	Potassium bromate			1.4E-04										
205	*	1120714	Propane sultone (1,3-)			6.9E-04										
206	*	57578	Propiolactone (beta-)			4.0E-03										
207	*	123386	Propionaldehyde						8							
208		115071	Propylene						3000							
209	*	78875	Propylene dichloride			1.0E-05			4							
210		107982	Propylene glycol monomethyl ether						2000							
211	*	75569	Propylene oxide			3.7E-06			30					3100		
212	**		Selenium and compounds						20							
213		7631869	Silica (crystalline, respirable)						3							
214		1310732	Sodium hydroxide											8		
215	*	100425	Styrene			5.7E-07			1000					21000		
216	*	96093	Styrene oxide			4.6E-05										
217			Sulfates											120		
218		7664939	Sulfuric acid						1					120		
220	*	1746016	Tetrachlorodibenzo(p)dioxin (2,3,7,8-)			3.8E+01			0.00004							
221		630206	Tetrachloroethane (1,1,1,2-)			7.4E-06										
222	*	79345	Tetrachloroethane (1,1,2,2-)			5.8E-05										
223	*	127184	Tetrachloroethylene			5.9E-06			40					20000		
224		811972	Tetrafluoroethane (1,1,1,2-)						80000							
225		109999	Tetrahydrofuran						2000							
226		62555	Thioacetamide			1.7E-03										
227	*	7550450	Titanium tetrachloride						0.1							
228	*	108883	Toluene						5000					37000		
229	*	584849	Toluene diisocyanate (2,4-)			1.1E-05			0.07					14		
230	*	26471625	Toluene diisocyanate (2,4-/2,6-)			1.1E-05			0.07							
231	*	91087	Toluene diisocyanate (2,6-)			1.1E-05			0.07							
232	*	95807	Toluene-2,4-diamine			1.1E-03										
233	*	95534	Toluidine (o-)			5.1E-05										
234	*	8001352	Toxaphene			3.2E-04										
235		76131	Trichloro-1,2,2-trifluoroethane (1,1,2-)						30000							
236	*	120821	Trichlorobenzene (1,2,4-)						2							
237	*	79005	Trichloroethane (1,1,2-)			1.6E-05										
238	*	79016	Trichloroethylene			4.8E-06			2					2		
239		75694	Trichlorofluoromethane						700							
240	*	88062	Trichlorophenol (2,4,6-)			3.1E-06										
241	*	121448	Triethylamine						7					2800		
242	*	1582098	Trifluralin			2.2E-06										
243		95636	Trimethylbenzene (1,2,4-)						7							
244		7440622	Vanadium						0.1					0.8		
245		1314621	Vanadium pentoxide											30		
246	*	108054	Vinyl acetate						200							
247	*	593602	Vinyl bromide			3.2E-05			3							
248	*	75014	Vinyl chloride			8.8E-06			100					180000		
249	*	75354	Vinylidene chloride						200							
250	*		Xylene (m-,o-,p-, or mixed isomers)						100					22000		

If any calculated long-term or short-term effects for an air toxic result in "Further Evaluation Required" (FER) on this Risk Screening Worksheet, a Refined Risk Assessment is required for that air toxic.

NOTE:

* **Clean Air Act hazardous air pollutant**

** **Clean Air Act hazardous air pollutant, but not listed individually (part of a group)**

a Dioxins may be considered to be all 2,3,7,8-tetrachlorodibenzo(p)dioxin), or separated into congeners (contact AQEv).

b PAH or POM may be considered to be all benzo(a)pyrene, or separated into individual PAHs (contact AQEv).

The results are determined by comparing the long-term and short-term effects to the single-source thresholds, listed below.
The threshold value of negligible risk for incremental risk (IR) is 1 in a million (1.0E-06). An IR value less than or equal to 1 in million is considered negligible.
The threshold value of negligible risk for long-term hazard quotient (HQ) for non-carcinogenic risk is 1.0. An HQ less than or equal to 1.0 is considered negligible.
The threshold value of negligible risk for short-term hazard quotient (HQ_{st}) for non-carcinogenic risk is 1.0. An HQ_{st} less than or equal to 1.0 is considered negligible.